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LIGHT FIGHTER COMMUNICATION -- ON TODAY'S CHEMICAL
BATTLEFIELD

A Thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

THOMAS J. HALE, MAJ, USA
B.S., United States Military Academy, 1975

Fort Leavenworth, Kansas
1988

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS N/A	
2a. SECURITY CLASSIFICATION AUTHORITY N/A			3. DISTRIBUTION/AVAILABILITY OF REPORT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS LIMITED	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A				
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION US ARMY COMMAND AND GENERAL STAFF COLLEGE		6b. OFFICE SYMBOL (if applicable) ATZL-SWD-GD	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) FORT LEAVENWORTH, KANSAS 66027-6900			7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS	
			PROGRAM ELEMENT NO.	PROJECT NO.
			TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Light Fighter Communication--On Today's Chemical Battlefield				
12. PERSONAL AUTHOR(S) Major Thomas J. Hale				
13a. TYPE OF REPORT Master's Thesis		13b. TIME COVERED FROM 8-1987 TO 6-1988	14. DATE OF REPORT (Year, Month, Day) 1988, June 3	15. PAGE COUNT 190 198
16. SUPPLEMENTARY NOTATION				
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	Chemical Warfare, Light Force Operations	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) (SEE REVERSE SIDE)				
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL			22b. TELEPHONE (include Area Code)	22c. OFFICE SYMBOL

19 ABSTRACT (continued)

The thesis problem is, "How well does communication within the "Light Fighter" force function on today's chemical battlefield." Chapter 2 reviews the history of chemical warfare and the evolution of the Chemical Warfare Service (CWS). First, this study presents the significance of the thesis problem. Second, the Soviet offensive use of chemicals is reviewed. Third, documented uses of chemicals in today's Third World Countries is presented. Fourth, a baseline communication model is established as a basis for comparison. Fifth, a fictional scenario is presented to illustrate light forces conducting combat operations in a tropical climate. The lessons learned are mentioned on the basis of studies conducted by governmental agencies and as illustrated in the scenario.

The lessons learned from this study are:

1. Communications suffer significantly in the chemical environment due to these factors: (a) exhaustion of leaders. (b) leadership behavioral changes and (c) the increased periods when no one is in charge.
 2. Radio and face to face communication are only one half as effective in the chemical environment as in a no threat environment and 38% of all radio messages must be repeated while in MOPP4.
 3. Battalion TOC efficiency suffers significantly in a chemical environment in the following areas: (a) written work and radio/telephone communications are subject to 40% more errors, (b) organic M51 Suelters cannot house a functional staff, and (c) more reliance is placed on gathering intelligence instead of planning for mission execution.
 4. Opposed amphibious assaults by soldiers wearing MOPP4, in a tropical environment are judged medically impossible.
 5. Training is the single most important factor in preparing a unit to fight and win on a chemical battlefield.
- A "Light Fighter" can communicate in a chemical environment. How effectively a force can communicate is directly dependent on the amount of unit chemical training and the physical shape of the unit leaders.

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MASTER OF MILITARY ART AND SCIENCE

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

To Mom and Dad
for instilling a strong desire in me to see all tasks
through to completion

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ABSTRACT

LIGHT FIGHTER COMMUNICATION - ON TODAY'S CHEMICAL BATTLEFIELD: An analysis of how effective communication within the "Light Fighter" force is on today's chemical battlefield.

The format of the thesis is as follows: Chapter 1 is an introduction; Chapter 2 surveys the history of chemical warfare and the evolution of the Chemical Warfare Service (CWS); Chapter 3 reviews the Soviet offensive use of chemicals; Chapter 4 presents a fictional scenario to illustrate the communications problems of the light fighter under combat conditions in a tropical climate; and Chapter 5 assimilates key scenario communication events with applicable governmental and field studies conducted since 1969.

The thesis scenario logically discusses and portrays today's chemical equipment and NBC communication training. The scenario's intent is to challenge a leader to analyze how a unit could be properly trained and maneuvered in today's low-intensity chemical battlefield. *keywords: lessons learned*

The lessons learned from this study are: *Theses. (SAS)*

1. Communications suffer significantly in the chemical environment because of the following factors: (a) exhaustion of leaders, (b) leadership behavioral changes, and (c) the increased periods when no one is in charge.
2. Face-to-face communication is only one-half as effective in the chemical environment as in a no-threat environment and 38% of all radio messages must be repeated while in MOPP4.
3. Battalion TOC efficiency suffers significantly in a chemical environment because of the following: (a) written work and radio/telephone communications are subject to 40% more errors, (b) organic M51 Shelters cannot house a functional staff, and (c) more reliance is placed on gathering intelligence instead of planning for mission execution.
4. Opposed amphibious assaults by soldiers in a tropical environment wearing MOPP4 are judged medically impossible.
5. Training is the single most important factor in preparing to fight and win on a chemical battlefield.

A "Light Fighter" can communicate in a chemical environment. How effective the communication is depends on the amount of unit and individual chemical training and the physical conditioning of the unit.

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CHAPTER 1

I. THESIS PROBLEM

How well does communication within the "Light Fighter" force function on today's chemical battlefield?

II. BACKGROUND

Section IIA of the Review Of Literature Chapter reviews the relevant background information concerning the history of chemical warfare and the evolution of the Chemical Warfare Service (CWS).

III. METHODOLOGY

First, this study will present the significance of the thesis problem; second is a review of Soviet Offensive doctrinal use of chemicals; third are examples of Third World countries where chemicals are presently being used or stockpiled. Finally, this study will present a baseline communications model.

After establishing this base, the study will examine the light fighter's capability to communicate on a chemical battlefield. The vehicle for the study will be a scenario set in Nicaragua. After the scenario portrays the effects

of chemicals on a light infantry task force conducting offensive operations in a chemical environment, the next step will be to analyze why certain events happened. By bringing together various experiments and studies on the subjects of communicating and performance in a chemical environment, logical time sequenced critical events are developed. The focus of the analysis will be on effective communications during each phase of the unit's offensive operations.

Snapshots of the various command levels from squad to the Battalion Tactical Operating Center will be presented over a time continuum which begins on D - 2 and ends on D + 2 with the units adapting to conditions on a chemical battlefield. Key events will be analyzed to evaluate the suspected physiological and psychological effects on the light infantryman. The specific levels of communication that will be addressed are: face to face communication by the squad leader and the platoon leader; radio communication between the company commander and the platoon leader; radio communication between the company commander and the task force tactical headquarters; and, lastly, the operation of that battalion tactical headquarters.

Factual data for troop performance used in the scenario is derived from a general comparison between data provided by the various experiments such as the CANE FDTE (Combined Arms Nuclear/Chemical Environment Force Development Test

Evaluation) study, field test information and my own practical experience. Information concerning employment of chemicals is from the following sources: U.S. Army Field Manual 3-10 and 4-60 as well as from the authors: David M. Glantz, David C. Isby, David Segal and William A. Ross.

Army Training Battle Simulation (ARTBASS), as outlined in Field Circular 101-2, is a chemical battle simulation that can be used to simulate brigade down to platoon size elements. This is the present fielded simulation that is supposed to show leaders what to expect from operating in a chemical environment. A brief analysis, addressing if this simulation is accomplishing its assigned task, is at the end of Chapter 4.

IV. SIGNIFICANCE OF THE STUDY

It is important to know if a "light" unit can successfully communicate on today's chemical battlefield. If the answer is no, the military must seriously reconsider current doctrine on employing "light" units. A unit that cannot effectively communicate is not mission-capable.

Previous studies do not adequately address the research question. The majority of past studies have been done analyzing the effects of chemical/biological agents on soldiers in a static defensive position. Furthermore, each study or experiment seems to have concentrated on separate questions or on single pieces of a puzzle. For example,

studies have been done on the effects of MOPP4 (Mission oriented protective posture) on soldiers performing stressful tasks and studies have been done on weapon firing while in MOPP4, but the two studies were never linked. This research considers these other experiments and studies as their results relate to communication within the context of a light infantry battalion task force.

This study focuses on offensive operations since the infantry cannot win battles while maintaining a defensive posture on or off a chemical battlefield. Offensive capability is critical in a Third World Country where low intensity conflict is most likely to occur. Low intensity conflict is characterized by an enemy that will not capitulate until his means of resistance is destroyed.

V. Overview

A. History

The chemical warfare lessons learned from World War I centered in two main areas. These areas are: (1) training and (2) leadership. Soldiers first needed to be educated about their individual chemical equipment and individual decontamination techniques. Secondly, combat leaders needed to learn chemical defense and what level of supervision is required during chemical operations. Lastly, the leader needed to realize that it was his job to ensure strict

adherence to unit standard procedures governing actions during and after a chemical attack.

Today, we face many of the same challenges. In evaluating the performance of the task force, these methods are covered in greater detail. Military leadership plays a large role in many of the above listed methods.

Military leadership, or the ability to influence the actions of others is the fundamental element of all tactically successful operations. Clausewitz's concept of command leadership embodies the description of the nature of the military "genius". The two features of military "genius" are: character or a strong will and distinctive personality traits. 1

The chaos of battle erodes not only leadership but also its application. In battle, the application of military leadership is the effectiveness of the unit's command and control. Battlefields have always been characterized by smoke and noise. The victor ultimately communicated his plan and controlled his forces better and with more alacrity than his opponent. FM 100-5 defines the ultimate measure of command and control effectiveness as whether the force functions more effectively and more quickly than the enemy.2

Consequently, successful communication is a key to effective command and control. Lieutenant Colonel Newell addresses "fog and friction" on a battlefield in communication terms. Newell's main point is that effective

battlefield communications is not only issuing the correct order at the proper time, but also the conveyance of key items of information. 3 Leadership on today's battlefield must consider the unique conditions and restrictions that will be present.

The act of communicating is the key to effective command and control of a unit. The act of communicating and/or the word "communication" connote different things to different people. It is necessary to have a clear method in evaluating the act of communication. This study will address communications between various command levels. I will use a model to evaluate all communications and by so doing create a common point of reference. The model will be the Lesikar Communication Model found in Sanford and Hunt's Communication Behavior In The Organization. 4 The communications model is Figure 1.

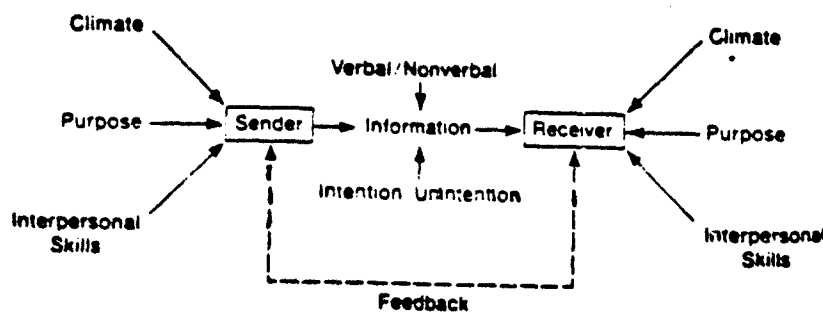


Figure 1. Lesikar Communications Model (From Communication Behavior In The Organization, 1976, pg. 36)

This model not only demonstrates some situational characteristics that influence a communication exchange, but focuses also on the environment effecting a communications exchange. These characteristics are: (1) the climate; (2) the perceived communication purpose of the sender and the receiver; (3) the communication skills demonstrated by the sender and the receiver; (4) whether the message has been intentionally or unintentionally transmitted; and (5) whether the message is verbal or nonverbal. More succinctly these variables are: climate, purpose, and interpersonal skills of both the sender and the receiver.

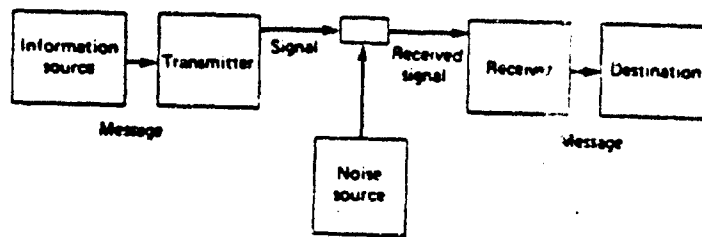
Climate or environment means not only the physical conditions surrounding the sender and receiver but also the emotional feelings of the participants about a communications exchange.

A purpose or objective is a vital part of every communications attempt. The most common failure in communication is the sender not transmitting his purpose to the receiver. In Lesikar's Model, purpose refers to the reasons why it is necessary for the participants to communicate.

The third environmental factor is interpersonal skills. Interpersonal skills can be further defined as the participant's speaking, writing, and listening skills. 5
The historically accepted communications model developed by

Shannon and Weaver (Figure 2) was not selected because it lacks a feedback mechanism.

Now let us look at chemicals, specifically from the viewpoint of being a significant contributor to today's battlefield "noise".



Shannon and Weaver Model¹⁴

Figure 2. Shannon And Weaver Communications Model (From Communication Behavior In The Organization, 1976, pg. 32)

B. Chemicals

Today, chemicals are being proliferated throughout the world and are readily available to any nation that desires to have its own chemical munitions stockpile. Neil Livingstone's, CBW: The Poor Man's Atomic Bomb stresses three deadly facts. These facts are: (1) the most deadly chemical weapons - the nerve gases - are as easy to manufacture as insecticides, (2) terrorists may be

particularly attracted to chemical/biological weapons because of their flexibility as a means of political revenge and (3) biological agents pose an even more catastrophic threat than nerve agents since minuscule amounts can produce infectious diseases with epidemic potential. A fertilizer plant has the capability to produce a nerve agent. Besides in-country production, a Third World Country might possess chemical weapons because of a superpower. It could be in the best interest of a superpower to allow a host country to stockpile and control chemical weapons which have been provided and produced by that superpower. In March 1982, Special Report #104 made by the Secretary of State to Congress stressed that chemicals are stored at Quandahar Airport, Afghanistan, which is an important staging area for Soviet military operations. If one couples the ease of production, the relative inexpensive means of chemical production, and the evidence that chemicals are present in Third World Countries, the assumption that chemicals will be encountered by forces of the United States operating in such countries is plausible.

U.S. Army doctrine maintains that "light" forces are ideally suited for combat in limited conflict type scenarios. This is one of the driving forces for the expansion of light infantry forces in the U.S. Army. Most experts agree that chemicals will be encountered in a limited conflict. These experts agree that chemicals will

be encountered because of: the ease and relatively inexpensive cost of producing chemical weapons, the increased political tensions in Third World Countries, and the demonstrated willingness of the United States to commit military forces to limited conflicts. Those committed U.S. forces will probably be "light" infantry. The "light" infantry is ideally suited for limited conflicts. The mission of these committed forces would be to conduct offensive operations in areas of the world where the enemy would not hesitate to stop aggression at any cost. Therefore, it is imperative that a "light" unit can successfully conduct offensive operations on a chemical battlefield. As stated previously, the key to successful combat operations is good communication.

ENDNOTES FOR CHAPTER 1

¹Karl Von Clausewitz, On War, Infantry Journal Press: Washington DC, 1943: 31-33.

²U.S. Army, FM 100-5, Operations (May 1986): 22.

³Clayton R. Newell, "Fog and Friction Challenges To Command and Control", Military Review, August 1987: 22.

⁴Aubrey Sanford and Gary T. Hunt, Communication Behavior In The Organization, Columbus, Ohio, 1976: 36.

⁵Sanford and Hunt: 32.

CHAPTER 2

This chapter identifies the sources used in addressing the thesis question and gives a brief summary of each source. The thesis question surfaces many sequels that lend themselves to future study. This chapter, coupled with the bibliography, will save future researchers critical time as they pursue the unanswered questions raised by this research.

For ease of reader reference the sources are classified into four broad areas. The four broad areas are: (1) communication, (2) chemical warfare, (3) performance degradation in a chemical environment, and (4) views concerning limiting the use of chemical warfare. Further, the area of "chemical warfare" is subdivided into the categories of history, doctrine, and artificial model simulations. The history section consists of both a general review of sources and a history of the use of chemicals.

I. Communication

Literature pertaining to communication provides two foundations. First, the review provides a baseline model

which allows quantitative evaluation of how effectively a unit's chain of command can communicate. This is done by analyzing snapshots of a unit as it follows the exercise scenario. Secondly, the review incorporates what other authors believe are major communications problems that leaders will encounter on the future battlefield.

Two texts summarized many of the different types of communications models. These texts were Joseph A. Devito's text entitled, Communication: Concepts And Processes and Sanford's, Aubrey's and Hunt's text entitled, Communication Behavior In The Organization. These reference works give the reader an appreciation for communications analysis. The basic communicative process is the same in these two works, but each model analyzed specific effects on communications from different perspectives. Another difference is some models do not include a feedback process which links the sender to the receiver.

The perspective selected as best suited for communication in a chemical environment was a model which considered environmental influences and provided a formal feedback mechanism. This model is from Raymond V. Lesikan's manuscript entitled, Business Communication: Theory and Application (1968). It generally addresses the areas of communication theory and business writing.

Lesikan's Communication Model analyzes the act of communicating from an environmental perspective. The

communication process is graphically depicted as being impacted by sign detection, sensory limitations, selective perception, reception of signals, natural filters, acts of encoding and effects of creativity. This model also allows both the sender and receiver a feedback mechanism which allows the players to judge how effectively they communicated. The figure below depicts Lesikars' Communication Model.

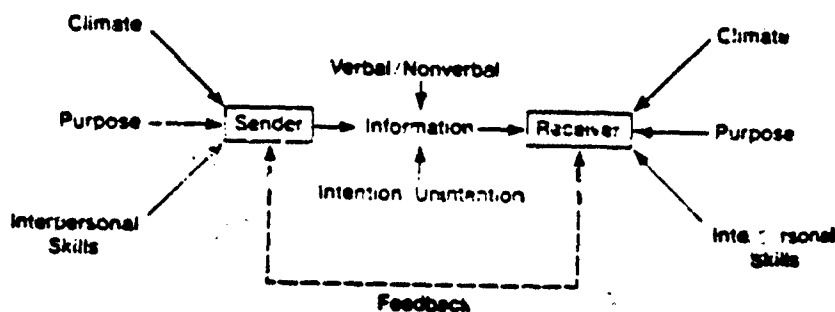


Figure 3. Lesikar Communications Model (From Communication Behavior In The Organization, 1976, pg. 36)

II. Chemical Warfare

A. History of Chemical Warfare

1. Review of Sources

For general background, the works of Alden Henry Waitt, Gas Warfare: The Chemical Weapon, Its Use, and Protection Against It, and Augustine Mitchell Prentiss Chemicals In

War: A Treatise On Chemical Warfare provide valuable information.

There are few definitive works which adequately cover chemical warfare during the historical periods of World War I and World War II. Chemical Warfare In World War I: American Experience, 1917-1918 and Chemical Warfare are two such books.

Charles E. Heller, Chemical Warfare In World War I: American Experience, 1917-1918 gives a good account of the American use of chemicals during World War I as well as noting the effectiveness of German chemicals against United States forces. Chemical Warfare by Fries and West deals with chemicals during World War I. Amos Fries was the first chief of the U.S. Chemical Service and his account is not only a complete history of the chemical service but describes the first German gas attack, the development of the gas mask, and tactics of chemical warfare in great detail.

An extremely interesting account of the actions of United States soldiers during World War I is found in a collection of notes compiled by the American Expeditionary Force Headquarters Service Of Supply Office in 1918. This collection, entitled "Notes On Gas Attacks Against The American Forces, April 9 to June 26, 1918," gives an excellent account of why soldiers became casualties. This is only one of many periodical reports compiled by the gas

officer for the Allied Expeditionary Force. This report combined the various detailed reports submitted by the various gas officers of the divisions. The information contained in this report includes: (1) detailed casualty reports, (2) detailed chemical agent analysis, (3) field commander's assessments of the battlefield situation, (4) lessons learned on how to employ chemicals or how to improve chemical defenses, and (5) the amount and type of chemical defensive equipment needed.

The Armed Forces Chemical Association in The Chemical Warfare Service in World War II: A Report of Accomplishments gives an excellent accounting of the actions of the U.S. Chemical Service during the Second World War. The information covered in this work is: (1) the state of readiness and organization of the Chemical Warfare Service (CWS) prior to the United States entry into World War II, (2) how the CWS organized for war from the Army down to the division levels, (3) research and development efforts during World War II, (4) evolution of chemical warfare training, and (5) an in-depth look into the evolution and the use of the 4.2 inch Mortar.

Gas Warfare by Colonel Alden H. Waitt is a technical presentation of chemicals, chemical weapons, defensive and offensive techniques for employment of chemicals and suggested gas shelters. This work is an excellent historical perspective on the evolution of the CWS before

and during World War II. Since this work was written in 1942 all the technical information on the chemical agents are out of date.

An excellent work which explains the tactics and the types of gases employed by the Germans, French and English is C.H. Foulkes work entitled, "GAS!" The Story of the Special Brigade. This work is also a unit history of the Special Brigade, a unit which Sir John French organized in June 1915 for the sole purpose of carrying out gas operations against the Germans. This book also describes the joint operation conducted by this British unit and the American Expeditionary Force in the Saint Mihiel Salient on 12 September 1918. The conclusions of this book are that chemical warfare is not a major problem for a well trained and well disciplined force and that the British had the most organized methods for gas offense and defense during World War I.

2. History Of Chemical Warfare

The first "modern" gas attack was delivered by the Germans on 22 April 1915. This attack took place north of Ypres, Belgium. The Germans released the gas cloud from metal cylinders placed in the their forward trenches. The wind carried the gas cloud into the Allied lines. All accounts agree that the result of this attack was horror,

confusion, and the death of approximately 15,000 men. 1 An eye witness account by the Reverent O.S.W. Atkins describes this use of chemicals:

.... Then we saw that which almost caused our hearts to stop beating-- figures running wild and in confusion over the fields. "The French have broken," we exclaimed,..... No human courage could face such peril. Then there staggered into our midst French soldiers, blinded, coughing, chests heaving, faces an ugly purple color--lips speechless with agony, and behind them, in the gas choked trenches, we learned they had left hundreds of dead and dying comrades. The impossible was only too true. It was the most fiendish, wicked thing I have ever seen.²

The gas used in the Ypres Offensive was chlorine. This type of gas must always be employed in a cloud to be effective. Chlorine gas is taken into the lungs resulting in immediate asphyxiation.

Major General Amos A. Fries, the head of the Gas Service of the American Expeditionary Force in France believed the nature of gas warfare changed when the Germans introduced mustard gas on 12 July 1917. 3 General Fries statement is true because of the unique characteristics of mustard gas. Unlike chlorine gas which only attacks the lungs, mustard gas assaults the whole body. Today, mustard gas is considered a persistent blister agent. Blister agents are both inhalation and contact hazards. The mustard

(H-agents) produce delayed casualties up to a few hours after contact. Phosgene oxine (GX), a blister agent, produces casualties immediately upon contact. Consequently, whole body protection is needed against blister agents. 4 To avoid confusion in later discussion of the various levels of mission-oriented protective posture (MOPP), the various levels are depicted in figure 4. MOPP Zero is carrying the mask only. MOPP 1 is wearing the overgarment but carrying the overboots, mask and gloves. MOPP 2 is wearing the overgarment and overboots but carrying the mask and gloves. MOPP 3 is wearing all pieces of the protective gear except the gloves. MOPP 4 is wearing all pieces of the protective gear. The following study will only concern itself with the differences noted between soldiers in MOPP Zero versus soldiers in MOPP 4.

The Germans used chemical weapons, during World War I, to cause casualties, to break morale, and produce delays as well as confusion. The general offensive of March 1918 demonstrates another aspect of the value of chemicals. It was during this offensive that the Germans neutralized the strongly fortified town of Armentieres, France, without a single German casualty. 5

The effectiveness of chemical warfare in producing casualties among United States personnel, during World War I, is shown in Figure 5. This figure depicts graphically,

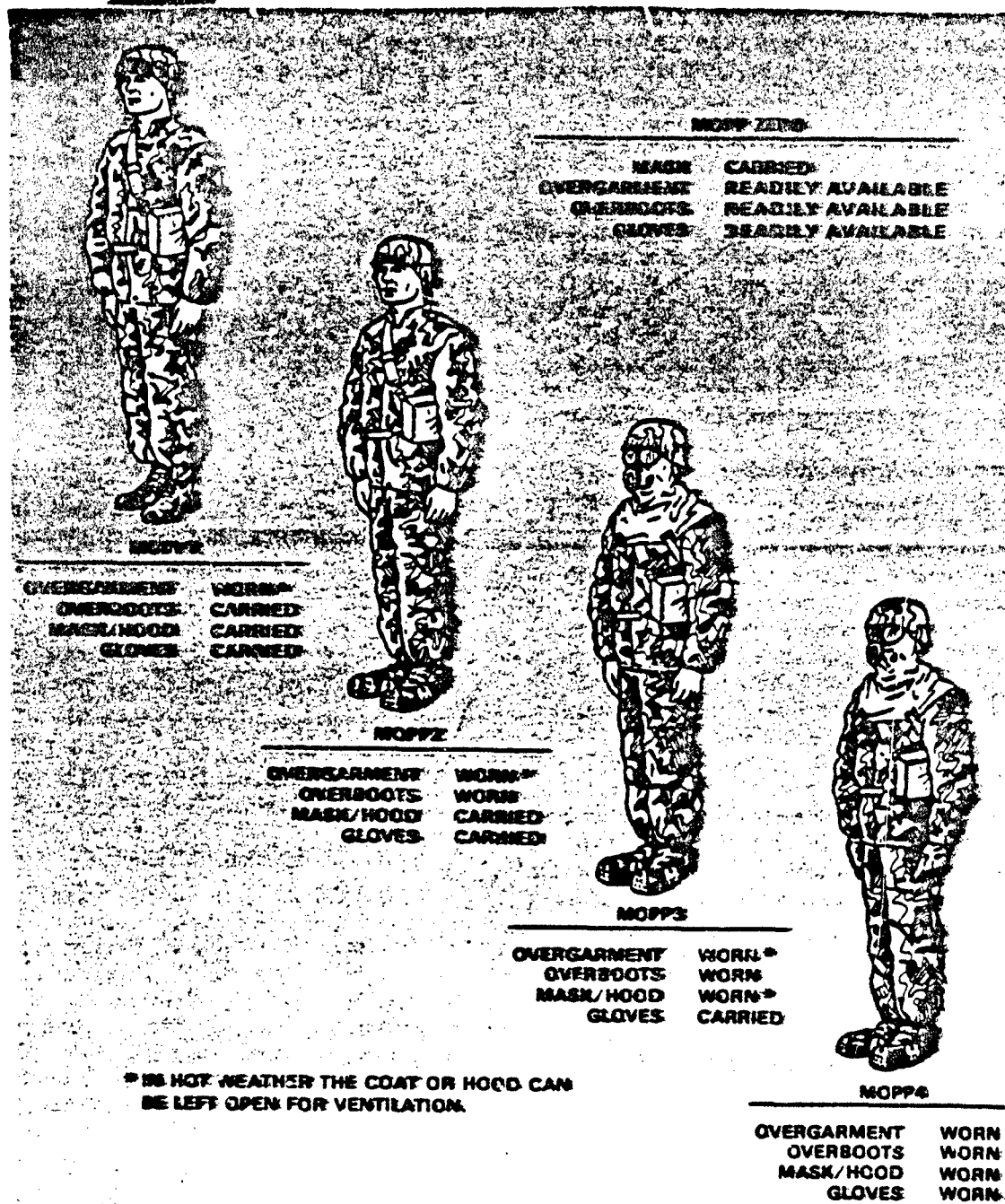


Figure 4. MOPP Levels (From FM 3-100, 1985, pg. 3-5)

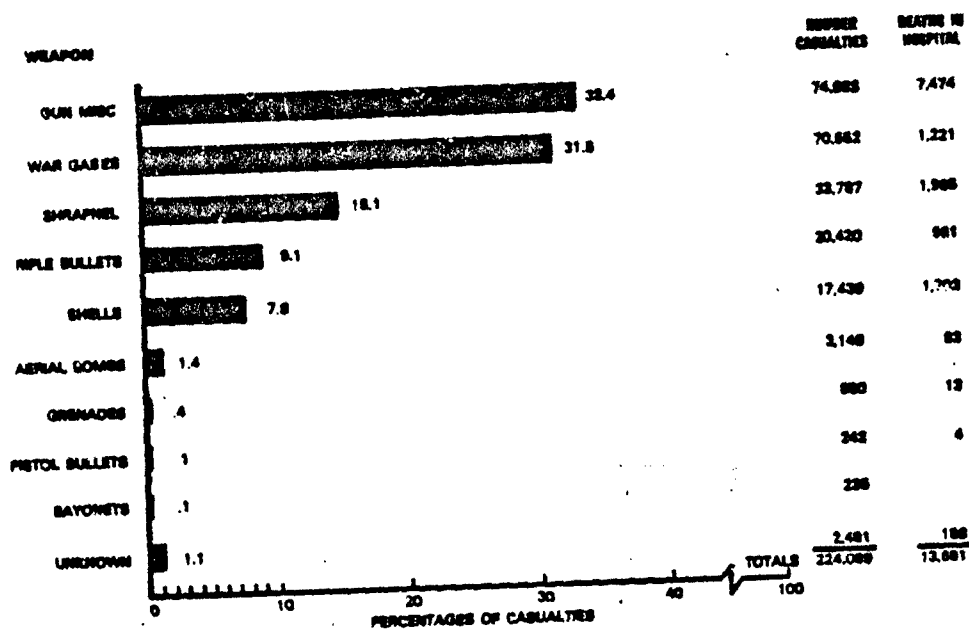


Table 2. Hospitalized casualties.

Figure 3. U.S. World War I Chemical Casualties (From Chemical Warfare in World War I: The American Experience 1917-1918, 1984, pg. 92)

by broad weapons category, United States casualties hospitalized during the First World War. 6 This data indicates that the only weapon that caused a higher percentage of battle casualties than chemicals was the gun. Gas warfare caused 70,552 hospitalized casualties or approximately 31.5% of all U.S. soldiers hospitalized.

The sheer horror or maybe the problems resulting from using chemicals on a battlefield encountered during World War I influenced the belligerent nations of World War II not to use chemicals. The United States Army provided chemical sections during the Second World War to the following Army Groups: Sixth, Twelfth, Fifteenth, and the Twenty-first.

The average chemical section consisted of from two to four officers and from four to eight enlisted soldiers. The division was the lowest command level where this section was inherently found. Since no chemicals were ever employed, this staff group became responsible for planning incendiary operations, fielding new weapons, employing the 4.2 inch chemical mortar, employing the mechanical smoke generator, and flame thrower operations.

The Allied forces in Europe used smoke operations extensively to help cover the many river crossing operations they conducted. 7 The use of smoke was considered standard operation by the current field manual for riverine operations of the 1940's.

During World War I and World War II, incendiary operations were linked with chemical operations. This is a misnomer. The most important control document of chemical and biological weapons, the Geneva Protocol of 1925, does not couple incendiary with chemical and biological weapons. A few examples of the period's incendiary weapons are: flame throwers, napalm, and incendiary bombs. These weapons are "physical" weapons producing their effects by blast and heat. Chemical munitions produce their effects by special toxic modes of action.⁸

There are various historically proven techniques or methods that can assuage the effects of a gas attack. These methods are as timely today as they were in 1915. These methods are soldier education, effective chemical training, soldier confidence in his issued protective equipment, timely and detailed enemy intelligence, good troop morale, and faith in the troop leadership. Information gleaned from an after-action report from a U.S. Infantry Regiment, dated 20 April 1918, states that the chief causes of chemical casualties were not adjusting one's own mask quickly enough, the premature removal of masks, and the handling of contaminated clothing while evacuating patients.⁹

B. Doctrine

Two historical manuals gave me an excellent understanding of the employment and the doctrinal chemical defense the American forces used during the First World War. These two field manuals are: Gas Manual Part I: Tactical Employment Of Gases A.E.F. and Gas Manual Part II: Use Of Gas By The Artillery A.E.F.. Part I stresses the importance of gas as weapons in military operations and discusses gas munitions by comparing their physical properties, physiological effects, and their persistencies. Also Part I discusses smoke operations.

Part II contains extensive technical details and data most relevant to those with a technical expertise in field artillery operations. This part deals with fuzes, different types of shells, and tactical use of the various types of artillery fires. It also gives guidance on expenditure rates of chemical munitions. Part II does describe the duties of a "gas" officer.

There is also an excellent article by William Ross in the 30 May 1987 issue of Jane's Defence Weekly Volume 7, Number 21, entitled, "Primary Role for Soviet Air Forces in the Delivery of Chemical Weapons". This short article surfaces some very important issues. First, Soviet doctrine states that only the Supreme High Command can release chemical weapons for use. Second, fixed and rotary wing

aircraft have been observed in Afghanistan using air-burst chemical munitions. It is the conclusion of the author that aircraft delivery of chemical munitions is the most probable means of employment of chemicals. The main targets of such munitions are nuclear weapon storage sites, command posts, troop concentrations, tactical logistics operations, rear area storage facilities, and airfields.

Field Manual 3-100 outlines U.S. chemical operations in U.S. Army. This superbly written manual covers every aspect from present U.S. policy for use of chemicals to actions against nuclear, biological and chemical (NBC) attacks. The last chapter applies NBC concepts to AirLand battle. Field Manual 3-100 gives an excellent summary of how NBC doctrine, detailed in other manuals, applies to today's battlefield. Other manuals take basic chemical warfare doctrine and loosely apply it to specific sized units: Field Manual 7-100, Field Manual 101-5, Field Manual 71-2, Field Manual 17-95, and Field Manual 1-111. The various field circulars that deal with specific sized units such as Field Circular 71-3 are also based on Field Manual 3-100.

Matthew Meselson in his study entitled, Chemical Weapons and Chemical Arms Control fully summarizes Soviet chemical warfare doctrine and describes the 1978 "state of the art" chemical munitions. Meselson's point is that the high political costs far outweigh the uncertain military gains resulting from a first use of chemical munitions.

David C. Isby in his 1981 work entitled, Weapons And Tactics Of The Soviet Army gives a technically accurate summation of the complete Soviet Army system. His book describes Soviet military doctrine which is a historical study of why the Soviets believe the only correct course of action is the offense. Also, Isby describes how Soviet military doctrine differs from the doctrine of the United States Army. The government and party systems have sanctioned Soviet doctrine, so it is considered "LAW". The United States Army cannot agree on its own doctrine and considers it only as a guide to the field commander.

In Chapter 11, Isby covers in detail the chemical warfare ability and doctrine of the USSR. This description ranges from how the head of the chemical warfare service interacts with the Soviet political leadership to the equipment used to decontaminate soldiers. This work not only has facts but pictures and diagrams to help the reader understand a particular piece of hardware or organization better.

C. Artificial Model Simulations

The purpose of studying model simulations was to gain an understanding how accurately these models reflect the data from field experiments and studies conducted by the government.

An excellent source to gain a general overview of all the war games in the Army inventory as of May 1982 is Quattromani, A.F., SAGAM 120-82, Catalog Of Wargaming And Military Simulation Models, 9th Edition. Once one gains this overview, it is easy to find directed material for each war game. Two highly technical studies on war games are Wallace's Simulation Of Tactical Alternative Responses (STAR), and Seyboth's Aggregated Force-On-Force Effectiveness Model.

Dr. Miller in his study entitled, "Army Training Battle Simulation System (ARTBASS) Study", generally describes ARTBASS and makes an observation that units which will use the model often do not request the chemical package which is available. Also, this simulation quantifiably measures a battalion size unit operating in combat performing offensive maneuvers.

These are the other model simulations I reviewed: JANUS, STAR, TACWAR, INWARS, BATTLE and AFFEM. Each of the listed models was not chosen for use in the study because of its design limitations or level of resolution. A brief description of each model follows with their shortcomings listed.

JANUS, is a conflict designed for mounted or heavy forces to fight a blue brigade against a red division level force. JANUS has a chemical package, but all game

Information is classified secret. Also, command and control communications are not explicitly modeled.

Simulation of Tactical Alternatives Responses (STAR) is a two sided simulation of the combined arms air/land conflict. Troops can be fought dismounted and engagements can be modeled from single vehicles up to and including a blue brigade versus a red division. Smoke can be played, but there are no chemical simulations.

The Tactical Warfare Model (TACWAR) is a theater-level model and goes down only to division maneuver units. This model can evaluate the effectiveness of opposing forces employing conventional, nuclear, and chemical weapons.

Integrated Nuclear and Conventional Theater Warfare Simulations (INWARS) was developed by BDM Corporation to specifically allow the examination of doctrine and issues in decision-making in a theater nuclear, chemical, and conventional context. This model focuses on command and control elements at echelons above division.

The Battle Analyzer and Tactical Trainer for Local Engagements (BATTLE), is a manual terrain board model capable of simulating all elements of a U.S. combined arms task force against the first echelons of a threat-motorized or tank division. This model has extremely limited and unrealistic nuclear, biological, and chemical play. 10

Lastly, is the Aggregated Force on Force Effectiveness Model (AFFEM). AFFEM is purely an artillery simulation in

which it is possible to play nuclear, chemical and smoke munitions.

In summary, I chose ARTBASS because it is: (1) a real time battle simulation, (2) tailored for a battalion size task force, (3) command and control oriented, and (4) an excellent unclassified chemical simulation package.

III. Performance Degradation in a Chemical Environment

The "CANE FDTE Study" conducted by ORI, Incorporated is a 3 volume compendium of sources and information. It is an excellent point of departure for any subject dealing with chemical or nuclear warfare.

The US Army Combat Development Experimentation Command at Fort Ord and the U.S. Army TRADOC Systems Analysis Activity at White Sands Missile Range have conducted the preponderance of experiments done in the chemical field since 1981. The reports on the experiments conducted at Fort Ord have been written in such a manner as to allow the reader to understand the purpose and results quickly. The published January 1981 study conducted by Turner and Redden entitled Force Development Testing and Experimentation of Parachute Procedures In Chemically Contaminated Areas (PAPRICCA) found that the current chin strap worn by airborne soldiers is inadequate for a jump into a contaminated area. The U.S. Infantry Board also determined:

(1) soldiers need to don overgarments and boots prior to the parachute, don helmet and mask 10 minutes prior to boarding the aircraft, and don the CB gloves at the ten minute warning; (2) use static jumpmasters; and (3) a jumper needs to clear and seal mask after canopy check. The major conclusion is that NBC equipment should only be worn on daylight jumps.

Another such Fort Ord experiment took place in January 1981 entitled "Mobility Through Contaminated Areas Test (MOCAT)". This was an eleven day test performed from 17-29 October 1980 at Fort Hunter Liggett, California. The purpose of this evaluation was to analyze a fire-team-size maneuver unit's survivability and performance in a chemical environment. This evaluation was conducted in daylight as well as during periods of limited visibility. The results were interesting and well-documented.

This test timed the dismounted crossing of a 450 meter and a 350 meter square area by soldiers in MOPP level 4. As a broad planning figure it took the troops four times as long to cross the same area in MOPP 4 as in MOPP Zero.

The 5th Infantry Division at Fort Carson in 1969 wrote a report entitled, "Final Report METOXE II Troop Test". The main conclusion of this report is battalion and company-size units do not remain mission-capable while surviving for a prolonged period in a chemical environment. The major findings of this study were: (1) rate of dismounted

movement was significantly degraded, (2) the CBR TO&E organization caused unacceptable conflicts between CBR duties and TO&E duties, (3) the unit alarm and warning system was inadequate, (4) procedures for performing body functions result in troops contaminating themselves, and (5) the training agent used, SMOKE, was unrealistic and failed to motivate the soldiers.

The Andrulis Research Corporation in July 1980 sponsored a published study chaired by Doctor Carr. The title of this study is The Effects of Chemical, Biological Clothing and Equipment on U.S. Army Soldier Performance: A Critical Review Of Literature. The two main test situations that comprised this study were a Marine battalion-sized amphibious assault and an Army infantry company conducting offensive operations. Specific degradations the report noted were: (1) individual soldier skill inhibition due to the clumsiness of the chemical suit, (2) decreased work versus rest ratio due to heat exhaustion caused by the chemical suit, (3) the physiological effects of simulated sublethal doses of chemical agents and (4) the unit loss of combat effectiveness due to decontamination procedures. These conclusions are not well substantiated in the report.

A review of available literature did not disclose any experiments focusing specifically on how command and control of a tactical unit is affected in a chemical environment. However, an article entitled "Fog and Friction--Challenges to

Command and Control", written by Clayton R. Newell in the August 1987 issue of Military Review addresses general problems with command and control in combat. The cornerstone of this article is that communications must include not only the passing of information but conveyance of ideas as well. The article defines fog as anything which prohibits the commander from knowing what is actually taking place on the battlefield. Friction is a concept described by Clausewitz as anything that makes an easy task more difficult.

The Burroughs and Williams report entitled "Techniques For War Game Assessments Of Chemical Operations, Final Report," Volume I, is an excellent 1975 study on chemical defense. The purpose of the study was to provide field and laboratory data so as to characterize the effects of chemical weapons upon personnel and quantify the effects on defensive operations while in MOPP 4. This study also addresses decontamination procedures at battalion level and below.

James Koza headed a research team that analyzed how effective a ground tactical air control party would be in MOPP 4. This study entitled "Tactical Air Control System Chemical Warfare Defense Equipment Task Validation" was written in March 1982. This was the only unclassified study I could locate which analyzed combat situations. The report made the following surprising recommendations about the M17

series mask: (1) the performance of ground control parties were unacceptable while donning and wearing MOPP level 4, (2) accomplishment of organizational level maintenance tasks supporting the tactical air control party was acceptable, (3) the M17 series protective mask enhances the overall capability of the tactical air control party to perform their duties, and (4) the plantronics communication headset modified for this test was unacceptable.

A more exhaustive and technical physiological study was done by Craig and Froenlich. Their work entitled "Endurance Of Overheated Men In Exhausting Work," was completed in July 1968 at Edgewood Arsenal, Maryland. No new information or startling facts were uncovered. The summary of their study stated the following two facts: (1) that soldiers in MOPP4 will become heat casualties if a ten minute work break was not adhered to every 60 minutes, and (2) because leaders are more active they are the first heat casualties.

A March 1983 U.S. Army study entitled "Aviation Performance Assessment In a Chemical Environment, Volume I", tested APACHE helicopter crewmen while in MOPP level 4. The unclassified findings are: (1) pilots are able to fly and navigate low-level, contour and NOE flying without any problems in daylight, (2) daylight target identification and engagement are excellent, (3) during periods of limited visibility only 1 out of 3 targets were detected, and (4) during periods of limited visibility the crew took twice as

long to engage the target then during daylight simulations in MOPP 4.

John Rakoczy in November 1981 developed a test to determine, "The Effect of Chemical Protective Clothing and Equipment on Combat Efficiency". This experiment was conducted at Aberdeen, Maryland. This test analyzed specific types of units and their ability to perform tasks that were considered necessary for mission accomplishment in a tactical scenario. The following data on an Infantry Battalion Headquarters is typical of this study.

It was determined that it took 5 minutes to move the command post site 500 meters in 85 degree Fahrenheit temperature in MOPP level Zero. To move the same distance under the same conditions in MOPP level 4 took 15 minutes. To move the command post site 1000 meters in 85 degree Fahrenheit in MOPP level Zero took 10 minutes. Under the same conditions in MOPP level 4, it took 60 minutes.

An excellent graphic portrayal of soldiers in MOPP4 and their endurance performing work can be found in H. de V. Martin's Porton Technical Paper #989 entitled Safe Exposure Times For Men Wearing An Impermeable Clothing Assembly In Hot Conditions. The graphs depict how important ten-minute rest periods are during work periods and how prone leaders are to heat exhaustion. If a leader does not take a 10 minute break with the other soldiers every hour, it is 95%

probable that he will become a heat casualty after 3 hours of "light" work at a mean temperature of 20 degrees Celsius.

Another unclassified gem is Yarger's, Schwartz's and Goldman's 1969 study entitled An Assessment Of CBR Protective Uniforms During An Amphibious Assault In A Tropical Environment: Heat Study 69-10. The conclusion is that an amphibious assault is not possible in MOPP4 in a warm (Tropical) climate.

William Reynolds in December 1977 conducted a study for the U.S. Army Infantry Board entitled "Force Development Testing And Experimentation Of Collective Protection for Command, Control, and Communication Activities (ILL WIND)". The purpose of this study was to evaluate certain control and communication activities of an Infantry Battalion staff in an extended chemical threat environment. The major findings are: (1) most all activities take twice as long, (2) communication by radio and telephone are subject to more mistakes the longer the amount of time the user has been in MOPP level 4, and (3) fatigue of soldiers adversely effects written communications. On the third and fourth days of this six day tactical exercise, attack orders were less detailed, took twice as long to write and contained 150% more errors.

The one classified "confidential" source I reviewed, but have not used in my paper, rendered a gold mine of comparative data. This source was a March 1976 experiment

performed by the U.S. Army Combat Development Experimentation Command at Fort Ord, California. The title of this work is "USACDEC Observations And Military Judgements Grand Plot III". Volume 1, Supplement 1 of this report is classified SECRET. Volume 1 is the system description. The remainder of this report dealt with specific data concerning how much a soldier's performance is degraded while operating in a chemical environment. The main areas of degradation that were studied were: communication, vision impairment and heat stress.

IV. Views Of Limiting Chemical Warfare

General (Ret) F.J. Kroesen sponsored a published work entitled Chemical Warfare Study: Summary Report. This report was based on a lot of emotional appeal and future "what-if scenarios". The point it made was today's modernization program is worthless unless it is accompanied by a similar program aimed at surviving and fighting in a chemical environment.

Steven Rose, in his text CBW: Chemical And Biological Warfare, summarized the London 1968 conference on chemical and biological warfare. Rose describes the 1968 status of chemical and biological warfare and discusses ways to control its spread. He first describes the wide range of chemical munitions and microorganisms available. Next, he

gives examples of how these weapons have been employed. Lastly, he addresses legal and moral issues in light of first use of chemical munitions. This is a good jumping-off point for anyone comparing state of the art chemical munitions to those of the Vietnam era. He also writes about defoliants and napalm in detail.

In November 1982, the then Secretary Of State, The Honorable Alexander Haig Jr., in "Special Report #104," Chemical Warfare In Southeast Asia and Afghanistan: An Update given to Congress, specified that two countries were employing chemical weapons. The report states that both Soviet backed governments of Vietnam and Afghanistan were using chemicals to defeat the guerrilla forces opposing them. The report also confirmed that a large stockpile of chemical munitions exists at Quadahar Airport in Afghanistan. Also, "Special Report #98", with the same title as that of "Special Report #104," documented that since 1982, chemicals have been used in these two countries.

Joseph D. Douglas Jr. in the fall 1986 issue of Strategic Review wrote an article entitled "The Expanding Threat Of Chemical-Biological Warfare: A Case of U.S. Tunnel-vision". He accuses U.S. authorities of being too preoccupied with the nuclear arena and ignoring the possibility of terrorist operations and Third World conflicts employing chemicals. Mr. Douglas also builds a

case that the Soviet Union leads the field in the new dimension of generically engineered agents.

The August 1987 issue of Swiss Review Of World - Affairs, the article "Chemical Weapons in the Gulf War", written by Ulrich Imobersteg, discusses chemicals being used by Iran and Iraq in their ongoing conflict. Concrete evidence of both countries employing nerve agents, choking agents, and blister agents were found on the battlefield.

ENDNOTES FOR CHAPTER 2

¹John W. Kelley Jr., "A Study Of The Reaction Of Troops To A Chemical Attack", U.S. Army Chemical School, FT. McClellan Ala., 9 April 1962: 1.

²Amos Fries and Clarence West, Chemical Warfare, McGraw-Hill Book Company, New York, 1921: 11-13.

³Aiden H. Waitt, Gas Warfare, Duell Sloan and Pearce, New York, 1942: 19-20.

⁴Fries and West: 47.

⁵Waitt: 20-21.

⁶Charles E. Heller, "Chemical Warfare In World War I: The American Experience 1917-1918", Combat Studies Institute, Sept. 1984: 92.

⁷Armed Forces Chemical Association, The Chemical Warfare Service In World War II: A Report Of Accomplishments, Reinhold Publishing Corp., New York, 1948: 26.

⁸Steven Rose, CBW: Chemical And Biological Warfare, Beacon Press, Boston, 1971: 46-47.

⁹American Expeditionary Force Headquarters, "Notes On Gas Attacks Against American Forces, April 9 - June 26, 1918", U.S. Army, 1918: 3.

¹⁰The information in this paragraph is taken from A.F. Quattromanis, Catalog Of Wargaming And Military Simulation Models, SAGAM 120-82, Washington D.C., 1982: 67-728.

CHAPTER 3

I. PURPOSE

The purpose of this chapter is twofold. First, an explanation of Soviet and United States Army doctrine for the use of chemicals on today's battlefield. This is a key point since the Soviets train "friendly" national armies in their own tactics. Therefore, a Third World country that has been trained by the Soviets would logically employ chemicals in accordance with Soviet doctrine. The second purpose of this chapter is to establish that chemical warfare in a Third World country is a military reality. This chapter sets the stage for the scenario in Chapter 4 as well as establishes the possibility that such a confrontation could take place in the near future.

II. SOVIET DOCTRINE

The cornerstone of the Soviet Army is military doctrine. Military doctrine is the officially approved system for perceiving and analyzing the nature of war, how war will be waged, and with what weapons. ¹ The highest level of political leadership, the Politburo and the Party Chairman, determines military doctrine. ² Today's Soviet

and United States Army doctrine concerning the employment of chemical weapons have some similarities. The main similarity between United States Army and Soviet doctrine is both countries have synthesized the key operational role of nuclear weapons with the ability to fight conventionally if and when required.

Combat "activeness" is the Soviet's main principle of the offensive. The Soviet's stress bold and decisive action in all operations, even in the defense. The need to always be on the offense is historically ingrained into the Soviets. Since Lenin, the offense has been the foundation of all Soviet military doctrine. Simply stated, they believe only the offensive will yield victory; speed, shock and maneuver are the decisive components of the offensive.³

Since the end of World War II, Soviet offensive concepts have evolved with ongoing technological changes. Operationally, army forces would advance on a broad front in a single echelon of divisions with an army reserve dispersed in the rear. The Soviets would attempt to achieve surprise by using darkness, inclement weather, and marginal terrain to mask troop movement. Artillery, air force, and attack helicopter units would provide simultaneous suppressive fires to the depth of the enemy defense with fires concentrated in sectors where the penetrations are planned. Forward detachments of reinforced tank regiment or brigade size would push through any gaps in the defensive line and

attempt to cause as much disruption in the enemy rear areas as possible. The standard mission depth of an army's forward detachment is from 30 to 40 kilometers. The main forces would then exploit any penetration. An operational maneuver group (OMG) consisting of a reinforced tank division or similar force would prepare to exploit the army first echelon or any ground gains made by the reserves. Brigade-size air assault operations would be conducted 40 to 60 kilometers in support of one of the army's axes of advance.

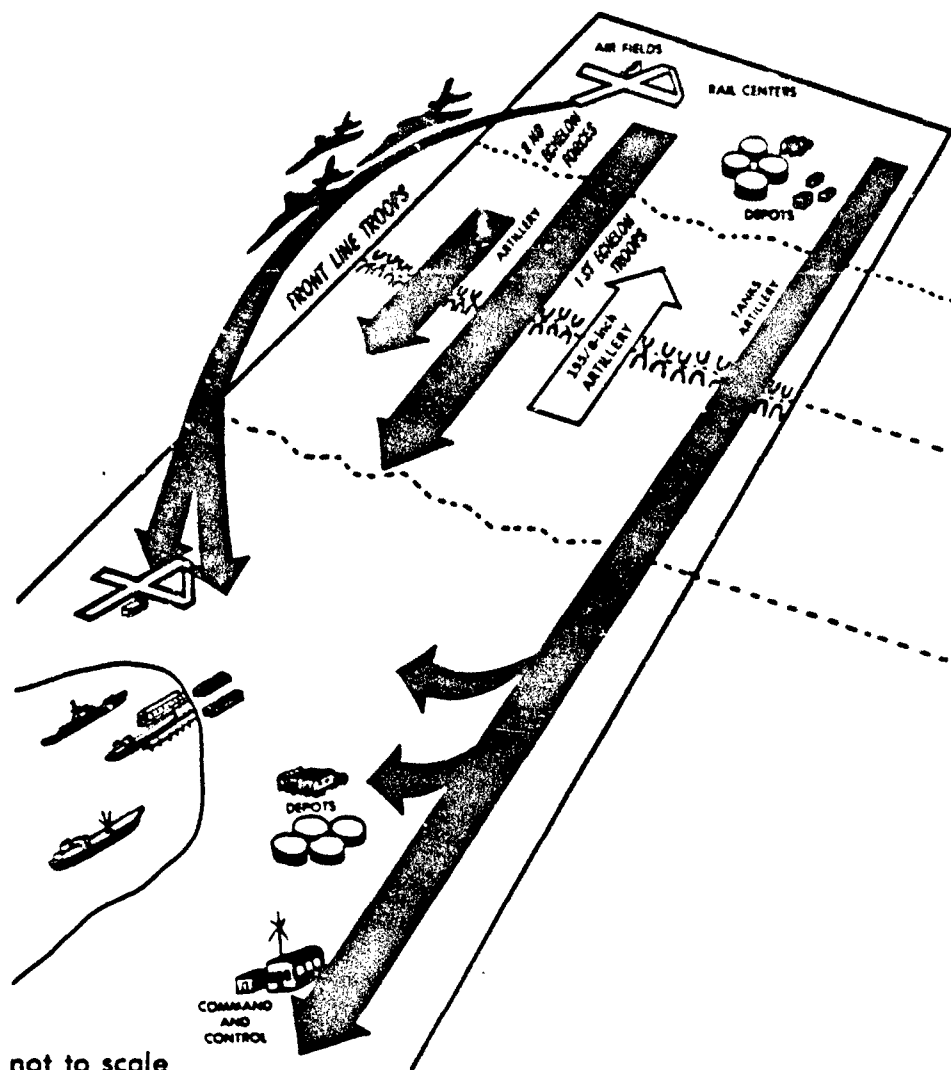
The Soviet's planned employment of an OMG fits three tenets of Airland battle doctrine found in FM 100-5. These applicable tenets are agility, depth and synchronization. 4 However, as long as the U.S. Army deploys corps and not armies we can never use an OMG. The main reason is a corps does not have the combat power for offensive maneuvers in the depths of an enemy force.

On the tactical level, Soviet motorized rifle and tank divisions would attack on regimental and battalion axes of advance in two echelon deep formations. A forward detachment from a division would lead the attack to attempt to break through the enemy's defense and penetrate 15 to 25 kilometers. Battalion-sized air assault operation will occur in conjunction with the objectives of the division's forward detachments. Division main forces will advance in pre-combat formation following the forward detachments.

Artillery and attack helicopter units will provide fire support. When each division reserve force has been committed, each division could then form an OMG to exploit its penetration or initiate pursuit operations once the enemy's defense is broken. 5

The Soviets believe that any future war will probably begin with a conventional phase. While Soviet literature open to public dissemination shuns the initial use of chemical warfare, their intense chemical warfare effort belies this claim. Reverses in battle or a slowing down of the offensive will probably result in the use of chemical weapons. 6 The decision to use chemical weapons will be made at the highest levels of the Soviet national command authority, "although in the 1950s and early 1960s the Soviets had reportedly already made the decision to use chemical weapons in an future war." 7 The consensus among Soviet military experts is that chemical weapons will normally be used in conjunction with nuclear or conventional munitions.

Soviet chemical weapons delivery systems include tactical aircraft (either aerosol spray or bombs), FROG and SCUD missiles, multiple rocket launchers of all sizes and all 122mm and larger tube artillery. Figure 6 illustrates how the Soviets out gun us chemically. Only, our 155mm or 8-inch artillery has a credible capability of firing a chemical round.



Soviets enjoy a 5 to 1 advantage in chemical munition delivery systems; a 4 to 1 advantage in types of agents; can attack our frontline units with a number of non-persistent agents (effects last only minutes to hours) and our rear with persistent agents (effects last days to weeks).

Figure 6. U.S. vs Soviet Chemical Delivery Means (From Chemical Warfare Deterrence Through Strength, 1984, pg. 1)

The Soviet's multiple rocket launchers and the missiles have the largest chemical warfare roles in their ground forces. This fact is related in a brief analysis of ammunition stockpiles. Multiple rocket ammunition stockpiles contain considerable amounts of chemical weapons, in excess "of the 5% proportion across all types of artillery ammunition". 8 Figure 6 is also a pictorial depiction of the Soviet's chemical munitions delivery systems as they would be used on a battlefield. Table 1 below indicates the Soviet ground force's maximum range per weapon system and the number of each chemical deployment system assigned to each type of deployed unit.

TABLE 1
Soviet Maximum Weapon Ranges

Chemical Warfare Delivery Systems (Soviet Ground Forces)				
Weapon	Maximum Range	Weight of Rocket or Warhead	Unit Deploying	Number of Weapons in Unit
122 mm	12 km	25.8 kg	Regiment	6
130 mm	27 km	33.5 kg	Army	36
152 mm	17 km	43.6 kg	Division	18
BM-21	15 km	45.9 kg	Division	18
FROG-7	60 km	450 kg	Division	4
Scud-A	80 km	680 kg	Army	3
Scud-B	280 km	770-860 kg	Army	3

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The Soviets manufacture and have stockpiled a wide assortment of chemical agents. Table 2 lists these potential chemicals and the anticipated delivery vehicles. 9 A brief comparison between the United States and Soviet inventory indicates an imbalance of the number and type of agents. This cursory comparison shows at least seventeen Soviet chemical agents compared to three (HD, GB, and VX) in the United States. 10

TABLE 2
List Of Potential Soviet Chemical Agents

Potential Soviet Chemical Agents	
Agent (U.S. Designation)	Delivery Vehicles
INCAPACITANTS	
Chloroacetophenone (CN)	Aircraft fragmentation bombs
Diphenylchloroarsine (DA)	
Adamsite (DM)	
K agents (K)	
NONPERSISTENT LETHAL AGENTS	
Chloropicrin (PS)	Massive aircraft bombs, artillery shells, rockets, missiles (<i>FROG</i> and <i>Scud</i> types)
Phosgene (CG)	
Diphosgene (DP)	
Cyanogen chloride (CK)	
Hydrogen cyanide (AC)	
PERSISTENT LETHAL AGENTS	
Mustard gas (H)	Aircraft fragmentation bombs, land mines
Mustard/lewisite mix (HL)	
Nitrogen mustard (HN3)	
NERVE GASES	
Tabun (GA)	Artillery shells, rockets, missiles (<i>FROG</i> and <i>Scud</i> types), aircraft bombs
Sarin (GB)	
Soman (GD)	
Thickened soman (VR-55 GD)	

The types of classical chemical agents that the Soviets could be expected to employ in war include the following:

- nerve agents (sarin (GB), soman (GD), and VR-53 thickened nerve gas);
- blister agents (mustard (H), lewisite, and a mixture of the two);
- a choking agent (phosgene CG)11

In addition to the above listed classical chemical agents, there are others that the Soviets can manufacture. One example is an agent that causes unconsciousness for an hour and has been reported as being used in Afghanistan.

The Soviets store and have used both persistent and nonpersistent agents. Persistent agents generally stay on the target from hours to days, depending on weather and temperature conditions. Nonpersistent agents will clear from the target area anywhere between five minutes to a few hours. This noted time differential is directly related to the terrain and temperature of the target area.

Several sources agree that the Soviets will attempt to use chemical weapons in such a way as to maximize the surprise effect. They will introduce chemical agents in a massive strike rather than in a gradual implementation. Nonpersistent agents are seen as excellent weapons of suppression, reducing the defender's effectiveness without preventing advancing Soviet units from attacking the position. They could also be employed where damage to terrain would slow the Soviet advance.

Tactically, both nonpersistent and persistent agents have key roles on today's battlefield. Nonpersistent agents could be used against an enemy in the following ways: (1) to secure choke points, river crossing sites, suspected assembly areas, ammunition sites or any other such points astride the main axes of advance, (2) to suppress resistance around drop zones or landing zones prior to an airborne drop or airmobile insertion, or (3) against troops in contact.

The intent in using chemicals against troops in contact is to gain that penetration point that Soviet offensive doctrine is based on. Persistent gases are ideal for interdicting supply and movement routes. Targets for missile-delivered persistent gas would be key airfields, POLICUS sites, nuclear storage and launch sites, railroad yards, staging areas, port facilities and headquarters. Well dug-in or fortified positions are also likely targets for a chemical strike.

Lastly, I need to discuss how chemical munitions could actually be delivered on the battlefield. It is general knowledge that the Soviets have delivered the chemicals used against the Afghanistan insurgents by both fixed and rotary wing aircraft. Aircraft can conduct chemical strikes using spraying, air burst bombs, and cluster munitions. Jet aircraft would not normally be used to spray liquid chemicals because liquid chemicals sprayed at high speeds are severely degraded. The relatively slow SU25 Frogfoot is

the one jet aircraft exception. 12 A technique of chemical munitions delivery used in Afghanistan has been verified by eyewitness reports. One of these reports states:

"air burst chemical bombs are dropped from helicopters; air-to-ground rockets are then fired into the chemical cloud to cause maximum cloud dispersion". 13

This chemical employment reported in Afghanistan can be considered by some as an example of chemicals in a Low Intensity Conflict. The generic employment of such chemical munitions can be taken as universal in all levels of conflict. These employment techniques will be reflected in the Chapter 4 scenario.

III. United States Army Doctrine

The United States Army Policy on use of chemicals is that this country would only use chemicals after an enemy first use. 14 The President of the United States must authorize the use of chemical weapons.

Chapter 5 of FM 3-100 applies NBC concepts to the airland battlefield. The key to the United States Army chemical warfare doctrine is "deterrence" as it is defined in Figure 7 from FM 3-100. The best deterrent against the use of chemical weapons is a good NBC defense and intestinal

fortitude coupled with the capability to retaliate quickly and in strength. 15

The two legs of deterrence are defense and retaliation. The three principles of NBC defense are: (1) avoidance, (2)

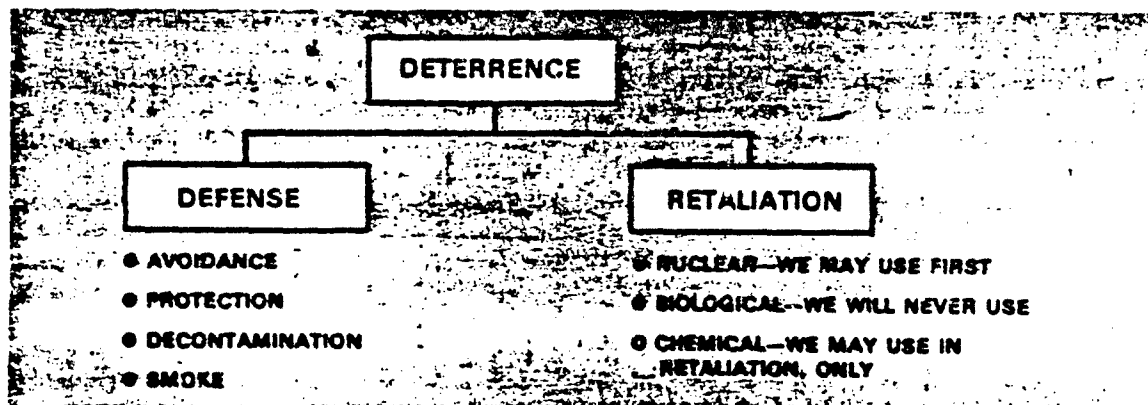


Figure 7. U.S. Chemical Warfare Doctrine (From FM 3-100, 1985, pg. 5-2)

protection and (3) decontamination.

There are both passive and active avoidance measures. FM 3-100, in Chapter 2, defines passive avoidance measures as those that are not a direct reaction to enemy chemical activity. Some examples of passive measures are operations and communications security, dispersion, training soldiers, issuing proper equipment and daily static initial position improvement. Active avoidance measures include marking contaminated areas, use of vocal and automatic alarms, and use of the Nuclear, Biological, and Chemical Warning and Reporting System (NBCWRS) to report a NBC attack.

Protection of soldiers include the following techniques: hardening positions and personnel, assuming the proper Mission Oriented Protective Posture (MOPP), providing personnel collective protective shelters, reacting quickly and effectively to an attack, and the prudent use of collective protective systems.

Collective protective equipment (CPE) on vehicles consists of these three systems: ventilated face piece, overpressure, and hybrid. 16 Hybrid includes a combination of the ventilated face piece and the overpressure system.

There are three levels of unit decontamination a commander can select. Figure 8 illustrates the three options which are basic skills, hasty decontamination operations and deliberate decontamination operations. It is generally agreed to by Army leaders that a deliberate decontamination operation can only be conducted in friendly rear areas and usually when a unit is being reconstituted.

The second leg of deterrence shown in Figure 7 is retaliation. FM 3-100 gives general guidance to a commander who is deciding the best way to employ chemical munitions. The six questions that FM 3-100 suggests are:

1. Is the target worthwhile?
2. Can the safety of our own force be assured?
3. Can the enemy quickly recover?
4. What is the enemy's protective posture?
5. What effect will the strike have on future operations?

6. What will be the acceptable level of damage to other than military personnel? 17

How chemicals are to be used on the battlefield is not an easy question to answer by using only United States Army doctrine. Since the use of chemical weapons is such an



Figure 8. U.S. Levels Of Decontamination (From FM 3-100, 1985, pg. 4-5)

emotional and politically volatile subject, the question is not directly answered. FM 3-10, however, gives some general guidelines to the military leader.

FM 3-10 groups chemical munitions in three general categories which are: point-source, multiple-point source, and line-source. As the name implies point-source munitions disseminate the agent from one source. Some examples of point-source munitions are land mines and aircraft delivered bombs. A multiple-point source chemical munition is made up of a number of point-source munitions that are placed in one area. Each point-source delivers the agent as an aerosol or vapor. A line-source chemical munition is delivered by aircraft and disseminates chemicals along the line of release. An example of this type of munition is a fixed wing or rotary wing aircraft mounted with spray tanks or armed with a bomblet-type munition being released against a linear target. 18 Table 3 lists the description of munitions that were available in 1971.

The actual strategy for employment of chemicals is different for the three types of munitions. These three types of chemical munitions are: lethal, incapacitating, and riot control. This study only deals with lethal and incapacitating chemical munitions. Employment of lethal chemical munitions is subdivided into three areas: nonpersistent chemical attack, persistent chemical attack, and chemical mine fields and barriers. FM 3-10 states that

a nonpersistent chemical attack is most effective when delivered to circumvent the enemy's protection against

Table 3
1971 Fielded Chemical Munitions

★Table 1. Chemical Munitions and Delivery Systems

Delivery system	Agent		Munition	Using service	Employment data			Average unit (platoon C) capabilities			Reference (para.)	
	Type	Avg wt (lb)			a	b	c	d	e	f		g
					Maximum range (meters)	Pace	Weapons	Average rate of fire per weapon	Area coverage (hectares) 1, 2, 3	Firing time	Effects	
a) mortar	MD	6.0	Cartridge, M241	ARMY	4,100	PD	4/Sec (6/Sec USMC)	50 rds/5 min	5.0	15 min	Casualty-producing vapor (skin)	60
				USMC				100 rds/15 min	4.5	15 min	Contamination of troops or terrain	
m) howitzer	GB	1.8	Cartridge, M200	ARMY	11,100	PD	4/Sec	3 rds/15 sec	0.5	TOT	Casualty-producing damage	54
	MD	9.1	Cartridge, M200	USMC	14,000			80 rds/15 min	2.5	15 min	Casualty-producing vapor (skin). Contamination of troops or terrain	56
m) howitzer	GB	0.6	Projectile, M122	ARMY	14,000	PD		1 rd/15 sec	1.0	TOT	Casualty-producing damage	58
	MD	9.7	Projectile, M110	USMC	18,000		2/Sec	12 rds/5 min	2.5	15 min	Casualty-producing vapor (skin). Contamination of troops or terrain	59
								20 rds/15 min	2.5	15 min		
	VX	0.6	Projectile, M122			VT					Contamination of troops or terrain	See FM 3-108
h) howitzer	GB	16.8	Projectile, M435	ARMY	10,000	PD	4/Sec (6/Sec USMC)	1 rd/15 sec	2.0	TOT	Casualty-producing damage	54
	VX	14.1		USMC		VT		4 rds/15 min			Contamination of troops or terrain	See FM 3-108
m) rocket launcher	GB	11.0	Rocket, M66 (THE BOLT)	ARMY	10,000	PD	3/Dia 500 lbs	40 rds/min/15 sec		15 sec	Casualty-producing damage	See FM 3-108
	VX	10.0									Contamination of troops or terrain	
m) rocket, JONES JOHN	GB	178.0	Warhead, M190 (M190 bomblets)	ARMY	30,000	MT	4/Sec	2 rds/hr	NA	NA	Casualty-producing damage	See FM 3-108
m) landmine	VX	11.5	M28 mine	ARMY	NA	Varying	NA	NA	NA	NA	Contamination of troops or terrain	27
	MD	9.9	1-gallon mine									See FM 3-108
lar, launcher, wall	GB	.....	Spray tank, Aero-14B	USMC		NA		NA			Casualty-producing damage	
	VX	.....	TM U-20B								Contamination of troops or terrain	
	GB	180.0	Dispenser, CBU-16/A (bomblets in line)	USAF		Impact					Casualty-producing damage	
	BS	60.0	Dispenser, (BUU-13/A) (CBU-16/A) (bomblets in line)								Incendiaries-producing damage	
	GB	.....	Bomb, MK 116, Mod 0	USMC NAVY		Impact					Casualty-producing damage	
	GB	.....	Bomb, MC-1, 750-lb.	USAF	Varies with munitions and loading configuration	Impact	See FM 3-108 for employment data	Bomb load varies with type aircraft	.....		Casualty-producing damage	See FM 3-108
	GB	.....	Bomb, MK 84, 1600-lb.	USMC NAVY		Impact					Casualty-producing damage	

conventional high explosive munitions. This guidance is interpreted as saying to use chemicals against close-in targets such as fixed field fortifications or hardened armor positions.

In U.S. offensive operations, the guidance is to use nonpersistent chemicals against all occupied targets throughout the depth of the battlefield. GB (nerve agents) can be used to produce casualties in the area selected for a penetration and to clear key choke points along an axis of advance. 19

In defensive operations nonpersistent chemical attacks could be used to disrupt the timing of the enemy's commitment of follow-on-forces, against enemy reserves or occupied assembly areas, and against areas to be bypassed. HD (blister agents), VX, or thickened nerve agents could be used to contaminate alternate defensive positions in an attempt to fix the enemy, and could also be used to assist in providing friendly troop flank security. 20

Chemical mine fields are most effective when they are used in conjunction with high-explosive mines to form a mixed HE-Chemical mine field. Such mine fields may be used to contaminate key terrain features, create obstacles, block river crossing sites, booby trap demolished industrial facilities, and canalize movement of a force through a built-up area.

Generally speaking, incapacitating chemical munitions can be used to neutralize hard targets, to separate intermingled military units, to neutralize selected or critical targets, against intermingled enemy, captured friendly, and civilian personnel in one area. 21

After this review of the basis for both the Soviet and the United States Army tactical employment of chemical munitions, the following will concentrate on the feasibility of nations to employ chemical munitions in battle. Any nation that has industrial chemical production capability can easily produce chemical agents.

IV. REALITY OF CHEMICAL WARFARE

WHETHER OR NOT GAS WILL BE EMPLOYED IN FUTURE WARS IS
A MATTER OF CONJECTURE, BUT THE EFFECT IS SO DEADLY TO THE
UNPREPARED THAT WE CAN NEVER AFFORD TO NEGLECT THE QUESTION.
PERSHING --- 1919

Page 10 of A Department of the Army Pamphlet, dated July 1984, entitled Chemical Warfare: Deterrence Through Strength asks the following question: "Isn't the threat of chemical warfare being exaggerated to bolster the cause of modernization?" The answer given is: "No. During our 15 year, unilateral, voluntary ban on the production of

chemical weapons, the Soviet Union has continued to amass the greatest offensive and defensive chemical capability of any nation on earth."

Like the United States, the Soviets have also taken the "no first use" pledge. It would seem, however, that their true intentions were made known in 1962, when Colonel Oleg Penkovskiy, a former high intelligence official, revealed the details of their chemical program. Colonel Penkovskiy stated, "If hostilities would erupt the Soviet Army would use chemical weapons against its opponents." 22 This same source maintains that the political decision to permit the use of chemical weapons has been made and Soviet planners have already developed plans which give field commanders discretion in the use of chemicals.

Russians believe in history. A historical fact is that Russian soldiers comprised 37 percent of the 1.3 million gas casualties inflicted during World War I. Another way to express the above statistic is that 62% of all World War I chemical fatalities were Russian. 23 The Russians seem to have taken a very pragmatic view of this problem. "They say, 'If gas has been used before it will be used again. This time we will be ready.'" 24 This attitude manifests itself by the buildup of Soviet chemical forces and their proliferation of chemical stocks to their allies.

The Soviet plan for offensive chemical warfare becomes more credible when viewed from the efforts they have taken

to protect their own troops. Since the late 1970s, there has been a proliferation and specialization of chemical warfare units to all echelons of the Soviet Armed Forces. This buildup has been concentrated in the ground forces. This buildup can best be assessed by dividing the force into two levels. These two levels are: (1) below division level and (2) above division level.

Below division level, chemical protection platoons have been placed in support of regiments. Proliferation of these special units has been most extensive above division level. Each Soviet army was previously thought to have one composite chemical defense battalion. Since 1987 that one battalion has grown to a number of independent battalions and companies. A chemical battalion is attached to each Soviet army, armored division as well as all mechanized divisions.

These chemical battalions have a total of sixty-six vehicles, thirty-two of them for decontamination. Each battalion contains three companies: two to decontaminate vehicles and equipment and one to decontaminate only personnel and clothing. Over and above this battalion, each division and army has an attached chemical forces platoon with the sole mission of decontaminating tanks and other large armored vehicles. 25

Figure 9 depicts the organization and personnel strength of a regimental NBC defense company, a divisional

Unit organisation

Regimental NBC defence company (tank and motorised rifle regiments)

Total strength: one officer, 34 enlisted men, two BRDM-rkh, two or three decontamination vehicles, two trucks.

Divisional NBC defence battalion (tank and motorised rifle divisions)

Total strength: 12 (18) officers, 138 (142) enlisted men.

One HQ and service company (three [four] officers, 30 enlisted men, one BRDM, three BRDM-rkh, 10 trucks)

Two personnel decontamination companies (each three officers, 36 enlisted men, one BRDM, six ARS-14s, three DDA-53, seven bowzers and trucks)

One equipment decontamination company (three [eight] officers, 36 [40] enlisted men, one BRDM, four [five] ARS-14, three TMS-65, six bowzers and trucks)

Figures in parentheses are for tank divisions where they differ from motorised rifle divisions. ARS-12/14 strength has been reportedly increased to 22 per battalion, and the number of TMS-65s increased as well.

NBC defence battalion (army)

Total strength: 44 officers, 474 enlisted men.

Headquarters and services (three officers, 30 enlisted men, two BRDMs, seven trucks)

Three chemical companies (each of 11 officers, 128 enlisted men, six ARS-14, two DDA-53, one TMS-65, 10 trucks)

One chemical reconnaissance company (eight officers, 60 enlisted men, 15 BRDM-rkh, five trucks)

NBC defence brigade (front level)

Total strength: 71 officers, 668 enlisted men.

Headquarters and services (11 officers, 73 enlisted men, two BRDMs, 12 trucks)

Three chemical battalions (each of 12 officers, 138 enlisted men, 18 ARS-14, six DDA-53, three TMS-65, 20 trucks)

One chemical reconnaissance battalion (24 officers, 181 enlisted men, 45 BRDM-rkh, 15 trucks)

NBC defence

The Soviets realise that for any force to survive in modern warfare it must take steps to defend itself against the NBC weapons that have the potential to dominate the battlefield. NBC defence is designed into all Soviet weapons and vehicles, incorporated into all Soviet strategy, operations and tactics. The technical aspects of NBC defence in the field fall to the Chemical Troops.

BRDM-2rkh vehicles being decontaminated. Some of the soldiers are wearing the dark-coloured heavy protective suits used by decontamination units. These suits are very thick and bulky.

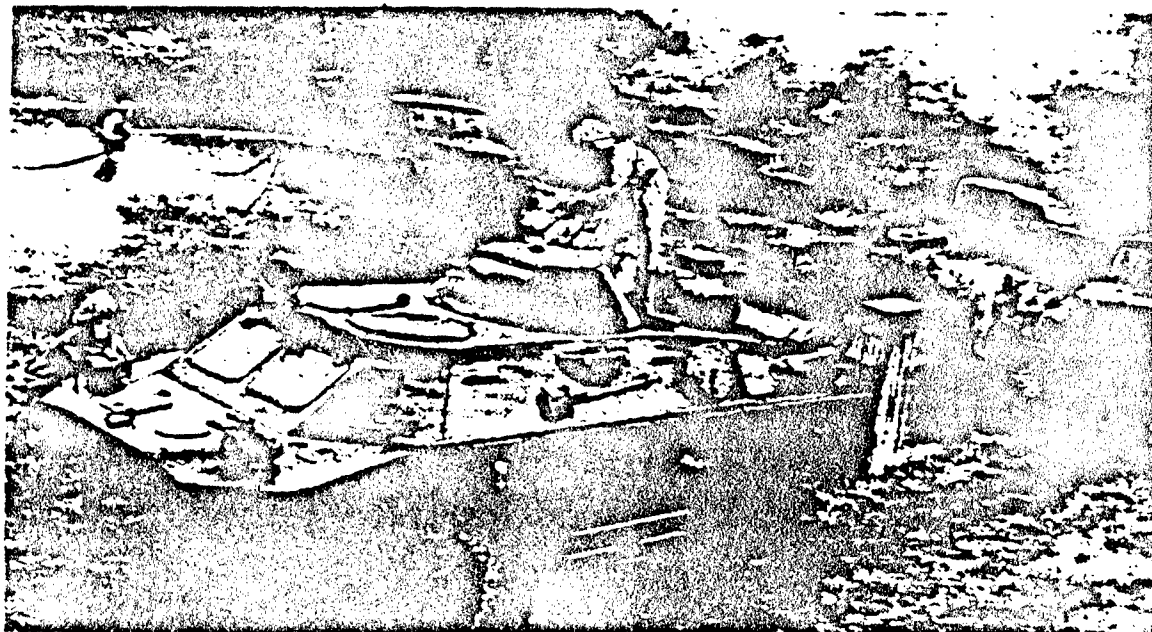
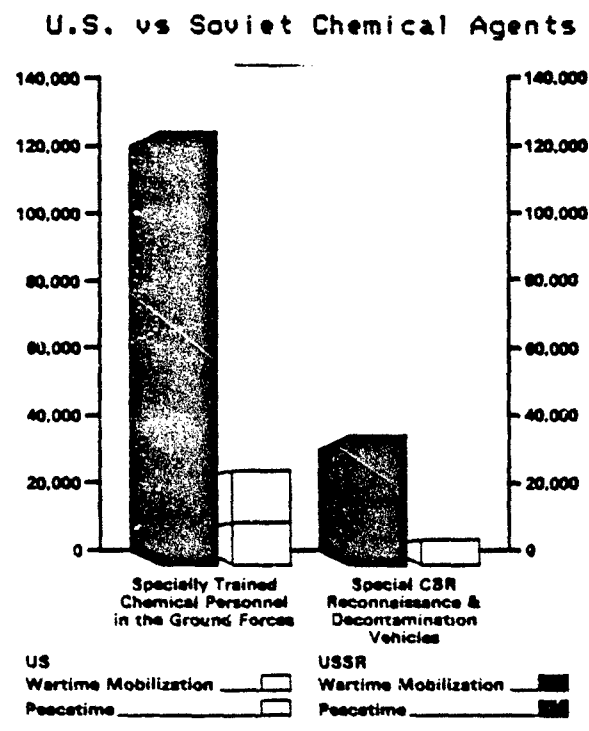


Figure 9. Soviet Army NBC Organization (From David Isby's, Weapons And Tactics Of The Soviet Army, 1981, pg. 215)

NBC defense battalion, an army level NBC defense battalion, and a front level NBC defense brigade. Increasing numbers of units usually reflect greater specialization. Functionally, each unit or subunit is designed to accomplish specific tasks. Those performing ground and aerial reconnaissance or detecting areas of contamination mark the boundaries of the contaminated zones and measure the level of the hazard. This information is processed and given to the operations staff. Attacking forces would then be maneuvered to avoid the hazard.

Additionally, special units have responsibility for the use of the light and heavy flame throwers as well as for

Table 4



smoke generation: Because of organizational expansion, the peacetime strengths of the Chemical Troops in the Soviet Ground Force alone now total more than 60,000, and this number will increase to 120,000 in wartime with the mobilization of the reserves. 26

Table 4 is a comparison of United States and Soviet Chemical Personnel and Equipment. As the chart indicates, the US has 10,000 soldiers on active duty and with total mobilization the figure would rise to 20,000.

The Soviets are proliferating this chemical organization throughout the world. Table 5 indicates the 1987 figures for major Soviet Equipment Delivered to the Third World. Figure 10, on the following page, is a

Table 5

Soviet Equipment In The Third World

*Major Soviet Equipment Delivered to the Third World 1981-1986**

	<i>Near East and South Asia</i>	<i>Sub-Saharan Africa</i>	<i>Latin America</i>	<i>East Asia and Pacific</i>	<i>Total</i>
Tanks/Self-propelled Guns	3,720	585	500	660	5,465
Light Armor	6,975	1,050	200	660	8,885
Artillery	3,350	1,825	800	530	6,505
Major Surface Combatants	22	4	4	4	34
Minor Surface Combatants	28	18	39	37	122
Submarines	9	0	1	0	10
Missile Attack Boats	10	8	6	2	26
Supersonic Aircraft	1,060	325	110	210	1,705
Subsonic Aircraft	110	5	0	5	120
Helicopters	635	185	130	75	1,025
Other Combat Aircraft	235	70	50	90	445
Surface-to-Air Missiles	11,300	2,300	1,300	375	15,275

* Revised to reflect current information.

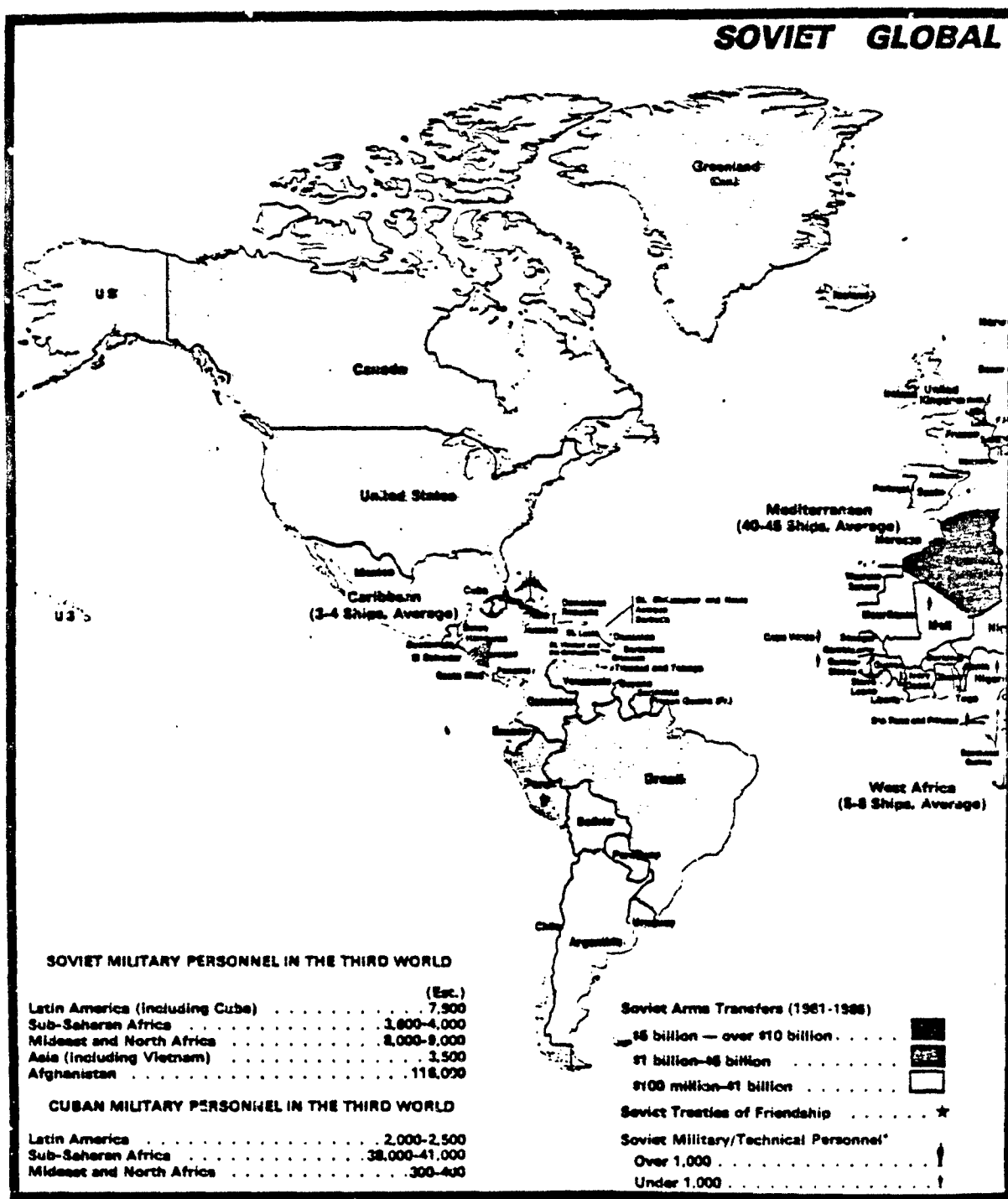


Figure 10. Global Location Of Soviet Arms (From Soviet Military Power 1987, pg. 128)

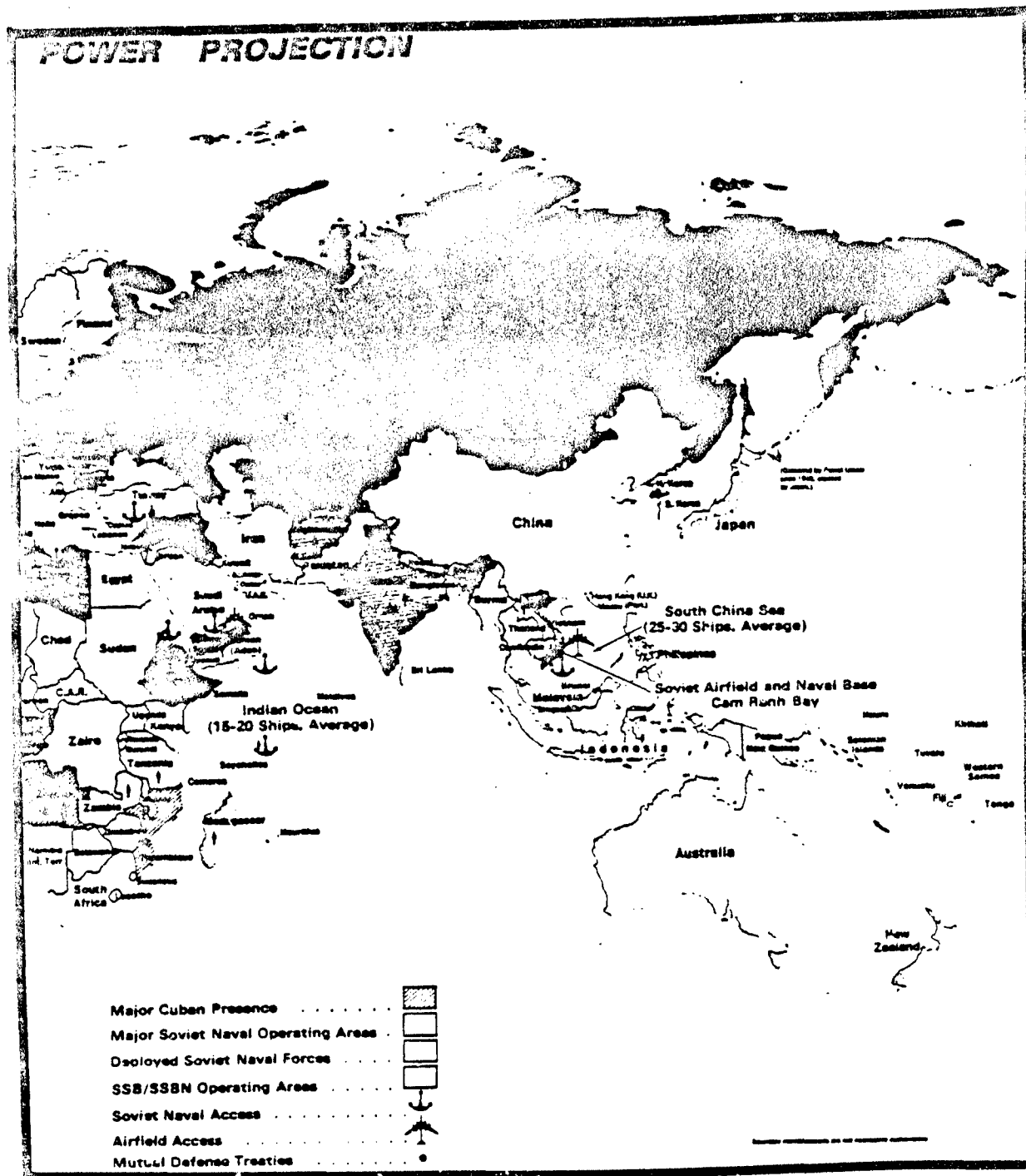


Figure 10. Global Location Of Soviet Arms (From Soviet Military Power 1987, pg. 129)

world map with Soviet military personnel and arms transfers marked. The Latin American and African nations should be noted since they are key players in the scenario developed in Chapter 4.

In Cuba, the Soviets have airfield access, naval access, and over 1,000 military/technical personnel. They have transferred between \$1 billion to \$5 billion dollars worth of arms from 1981-1986. In Nicaragua, the Soviets have under 1,000 military/technical personnel and have made sure there is a substantial Cuban presence. In Peru, the Soviets have less than 1,000 military/technical personnel and between 1981-1986 have transferred \$10 million to \$1 billion dollars worth of arms to Peru.

There is a Soviet presence in the African countries of Ethiopia, Libya, Algeria, Mali, Cape Verde, Guinea-Bissau, Guinea, Benin, Nigeria, Congo, Sao Tome and Principe, Angola, Zambia, Mozambique, Madagascar, and Tanzania. In Africa, the Soviets have naval and airfield access in Libya, Ethiopia, Angola, and Guinea-Bissau. In all the above mentioned African countries the Soviets maintain military/technical personnel: 27

Specific use of Soviet chemical munitions has been confirmed in Vietnam, Laos, Cambodia, Afghanistan, Iran, and Iraq. The USSR has supplied both chemical and toxic weapons to its client regimes in Laos, Cambodia, Vietnam, and

Afghanistan since 1975, and these regimes have used these weapons with little regard for international law. 28

The Vietnamese forces under the supervision of Soviet advisers used chemicals extensively to drive the H'mong from their mountain strongholds. 29 Use of these chemicals relieved the ground forces of Vietnam and Laos of the need for costly combat in difficult jungle and mountain terrain.

Soviet ground forces have used chemicals against the Mujahideen insurgents in Afghanistan. 30 Chemicals have been used in caves, rugged terrain, and the thick jungles located in Kampuchea forcing the insurgents to flee the area and inflicting heavy native casualties. 31 Stores of chemicals have been observed at Quadahar Airport in Afghanistan. 32

In April 1987 United Nations Secretary General Perez de Cuellar sent a commission of experts to Iran and Iraq to investigate charges about the use of chemical weapons by the two belligerents. Medical examinations of victims conducted in Iran concluded unequivocally that they had been wounded by a mustard or nerve agent. 33 Personnel who breathe chemical fumes suffer severe damage to bronchi and lungs. Many exposed personnel will die; those that do survive may suffer chronic pulmonary problems. In an Iraqi hospital this investigation team was shown personnel who exhibited signs of being poisoned by Phosgene. This chemical causes severe pulmonary damage and is fatal. 34

It is clear to me that a country trained by another will take on the characteristics of the trainer. It is clear the Soviets have no doubts about employing chemicals. Therefore, it stands to reason a country's army trained by the Soviets should have similar views about the employment of chemicals.

Now, let us follow a United States force into Nicaragua and see how a light infantry battalion task force can cope with chemical warfare. It is well known that there is a strong Cuban presence in Nicaragua and as Figure 10 indicates there are about 1,000 Soviet military advisers also assisting the army of Nicaragua.

ENDNOTES FOR CHAPTER 3

¹David C. Isby, Weapons And Tactics Of The Soviet Army, Jane's Publishing Company Limited, New York, 1981: 11.

²Ibid., 12.

³Ibid., 12.

⁴United States Army, FM 100-5 Operations, May 1986: 15-18.

⁵David M. Glantz, Soviet Offensive Ground Doctrine Since 1945, Soviet Army Studies Office, Ft Leavenworth (1983): 32-33.

⁶Isby., 209.

⁷Ibid., 214.

⁸Ibid., 214.

⁹David Segal, "The Soviet Union's Mighty Chemical Warfare Machine", Army, Volume 37 No. 8, (August 1987): 29.

¹⁰Ibid., 28.

¹¹Soviet Military Power 1987, US Government Printing Office, Washington DC, March 1987: 91.

¹²William A. Ross, "A Primary Role For Soviet Air Forces In The Delivery Of Chemical Weapons", Jane's Defense Weekly Z, 30 May 1987: 1053.

¹³Ibid., 1053.

¹⁴United States Army, Field Manual 3-100 NBC Operations, September 1985: 1-2.

¹⁵Ibid., 5-2.

¹⁶Ibid., 3-10.

¹⁷Ibid., 5-4.

¹⁸United States Army, Field Manual 3-10 Change 1
Employment Of Chemical Agents, 26 February 1971: 15-17.
All the information concerning the groups of chemical
munitions came from these pages.

¹⁹Ibid., 22.

²⁰Ibid., 23.

²¹Ibid., 24.

²²Staff, AUSA Position Paper, "Chemical Warfare -- A
Military Reality", Association of the United States Army,
Washington DC, 24 November 1976: 5.

²³Army, August 1987: 27.

²⁴AUSA Position Paper, 24 November 1976: 4.

²⁵Army, August 1987: 28.

²⁶Soviet Military Power 1987, 89.

²⁷Ibid., 128-129. The facts and figures used are from
this government report.

²⁸Army, August 1987: 29.

²⁹US Government, Chemical Warfare In Southeast Asia and
Afghanistan, To The Congress from the Secretary Of State,
Special Report #98, 22 March 1982: 17.

³⁰Ibid., 17.

³¹Ibid., 18.

³²US Government, Chemical Warfare In Southeast Asia and
Afghanistan: An Update, To The Congress from the Secretary
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³³Ulrich Imobersteg, "Chemical Weapons in the Gulf War",
Swiss Review Of World Affairs, (August 1987): 26.

³⁴Ibid., 27.

CHAPTER 4

I. INTRODUCTION

This chapter is the critical focus of this thesis. The threads of information that this chapter will tie together are: (1) the reviewed experiments and field data on infantry soldiers in a chemical environment, (2) the communication results of a light battalion task force while fighting on a chemical battlefield in a third world country, (3) an application of Soviet and U.S. military doctrine on such a battlefield and (4) the consideration of how communications is modeled when following this type of unit through a chemical battlefield scenario in ARTBASS.

These threads draw together by developing a scenario in which an LID is committed to a low intensity conflict in Nicaragua. Two groups are followed: one prepared and one not properly trained for combat on a chemical battlefield. This chapter will first discuss briefly the area, climate and population distribution of the scenario's area of operations. Second, it will describe the scenario of the light forces' employment into Nicaragua. The scenario will be the vehicle which I will use to demonstrate how the results of experiments and other field data, couched in a battlefield context, will affect a light infantry battalion's communication. Chapter 5 will give specific

lessons learned about communication on a chemical battlefield and how communication of a light infantry battalion task force is specifically affected. Third, the extent that ARTBASS trains leaders to consider communication on a chemical battlefield is addressed. The baseline model used to review communication is the Lesikar Communication Model, as described in Chapter 1.

Chapter 5 will consist of three distinct parts. These three parts will be: (1) a list of the major lessons learned, (2) an explanation of why certain events occurred in the scenario and (3) recommended questions for future study and analysis. Now that you know purposes of Chapters 4 and 5 and the specific plan of attack let us cross the line of departure.

II. INFORMATION ON NICARAGUA

Nicaragua resembles the state of Iowa in total land area, total population, and the unusually high quality of arable land. (See Figure 11.) Nicaragua covers 57,143 square miles and has 2.5 million people. Iowa covers 56,290 square miles and has 2.9 million people. 1 Figure 11 also illustrates the approximate nautical mile distance to Nicaragua from the North American Continent. Generally, from most continental United States staging bases, located outside of Florida, the straight line distances range from

1,200 to 2,400 nautical miles.

Nicaragua is bordered by the countries of Honduras in the north and Costa Rica in the south. On the west and east

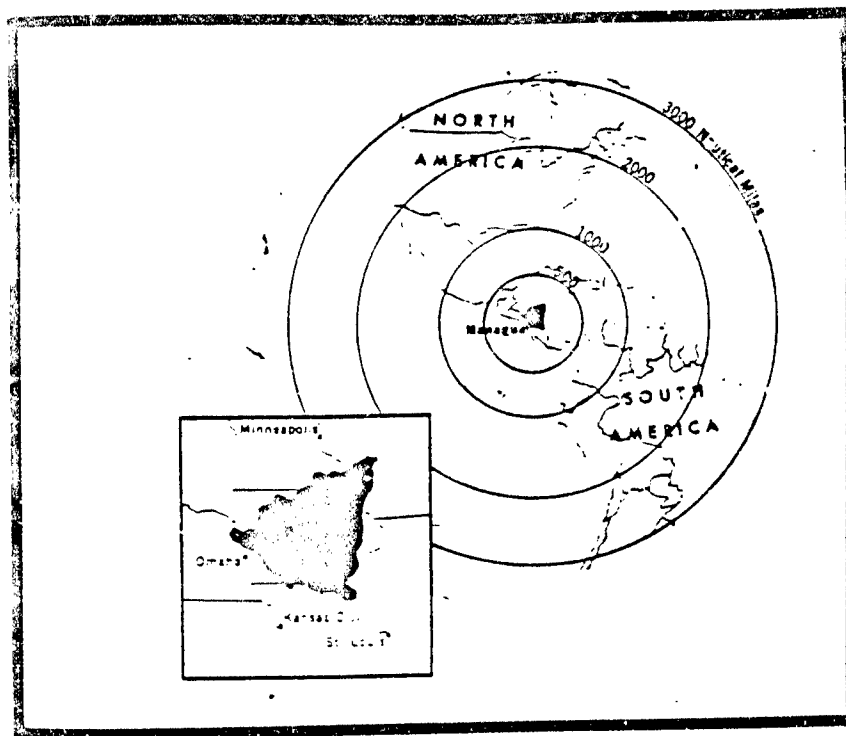


Figure 11. Nicaragua Global Perspective (From Map Series CIA, 504012, 1079 (544374))

of this country are the Pacific Ocean and the Caribbean Sea, respectively (Figure 12). Because of the location of the Lago de Nicaragua and the proximity of the Pacific Ocean and the Caribbean Sea, it is feasible that a second canal could be constructed to connect the Pacific and the Atlantic oceans.

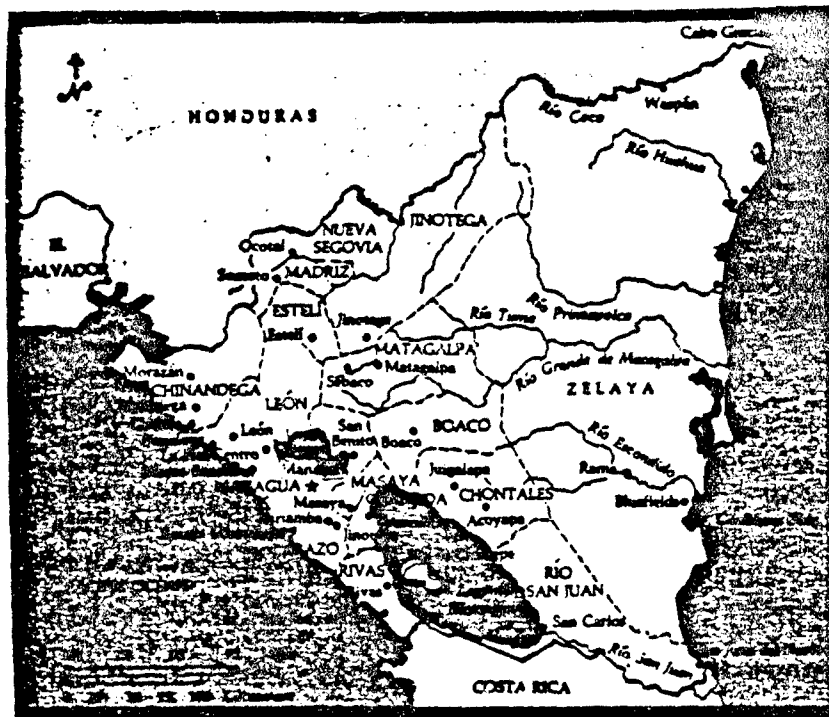


Figure 12. Map Of Nicaragua (From Nicaragua: The First Five Years, 1985, cover page)

Managua is the capital of Nicaragua and also the most heavily populated and built up area. The 1963 census indicates the city of Managua and the area south of the

Managua is the capital of Nicaragua and also the most heavily populated and built up area. The 1963 census indicates the city of Managua and the area south of the city has over 513 people per square mile (Figure 13).

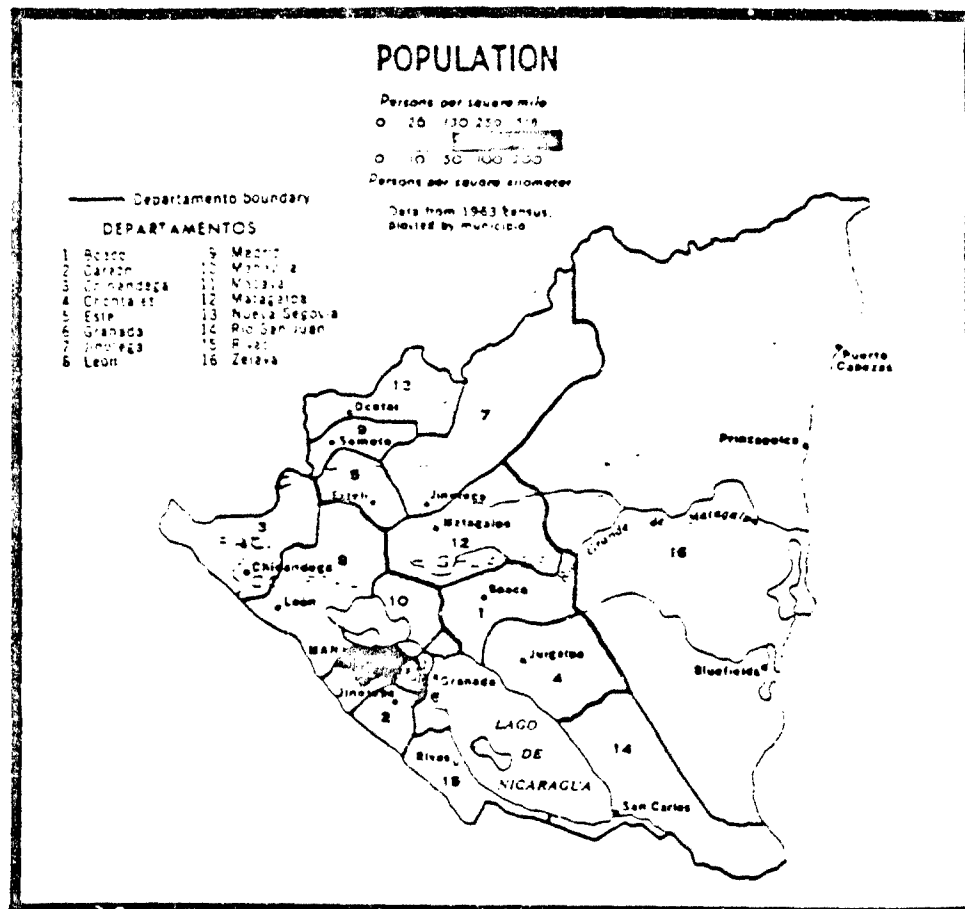


Figure 13. Population Distribution in Nicaragua (From Map Series CIA, 504012, 1079 (544374))

Figure 14 indicates the major economical activities of Nicaragua. In general, the mining of gold and copper is

located in the "Atlantic Littoral" or the northwestern portion of the country. The one major location for cotton and sugar cane production is in the Pacific coastal belt along the western coast near the town of Chichigalpa. Coffee is the other main crop and cultivation of this labor intensive crop is scattered throughout the "Central Highlands" and one area on the Pacific coast near the town of Jinotepe.

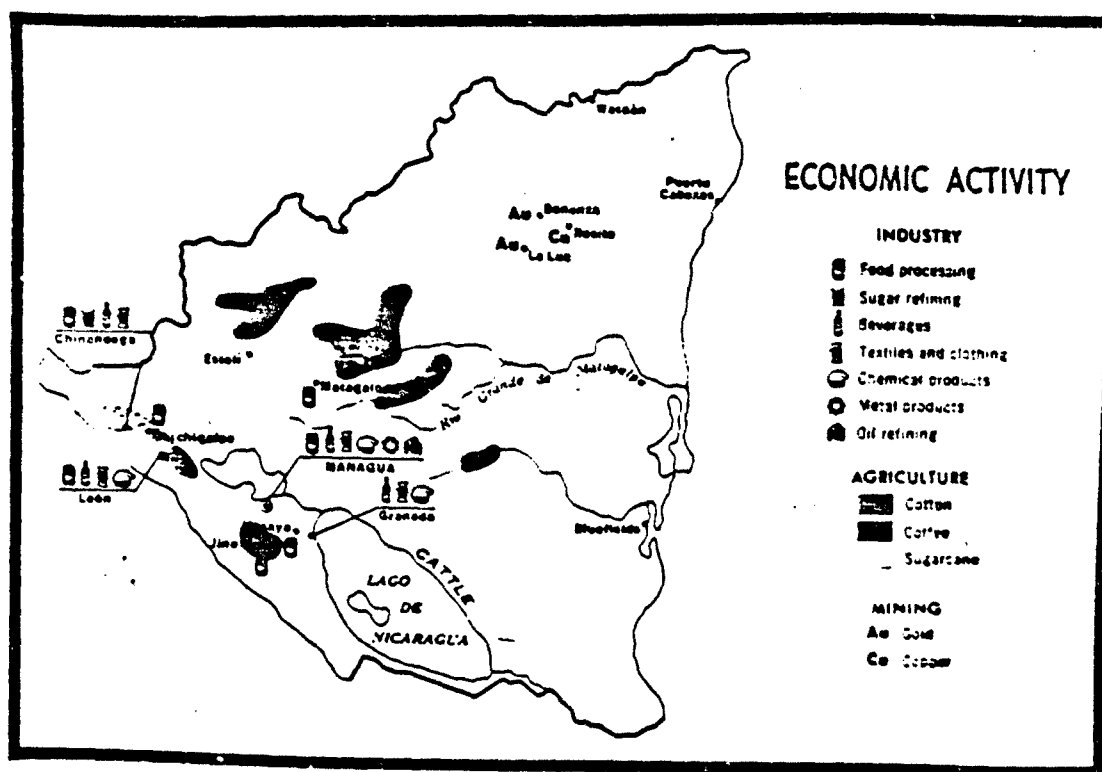


Figure 14. Economic Activity In Nicaragua (From Map Series CIA, 504012, 1079 (544374))

Figure 15 shows the type of terrain that Nicaragua has. As one can see, it is not all dense tropical rain forests. The scenarios area of operations will be the area south of Route 16 running between San Juan Del Sur and San Carlos on the Lago de Nicaragua and south to the Border of Costa Rica. Map 1 is the attached 1/250,000 Map Sheet and shows the area of operations.

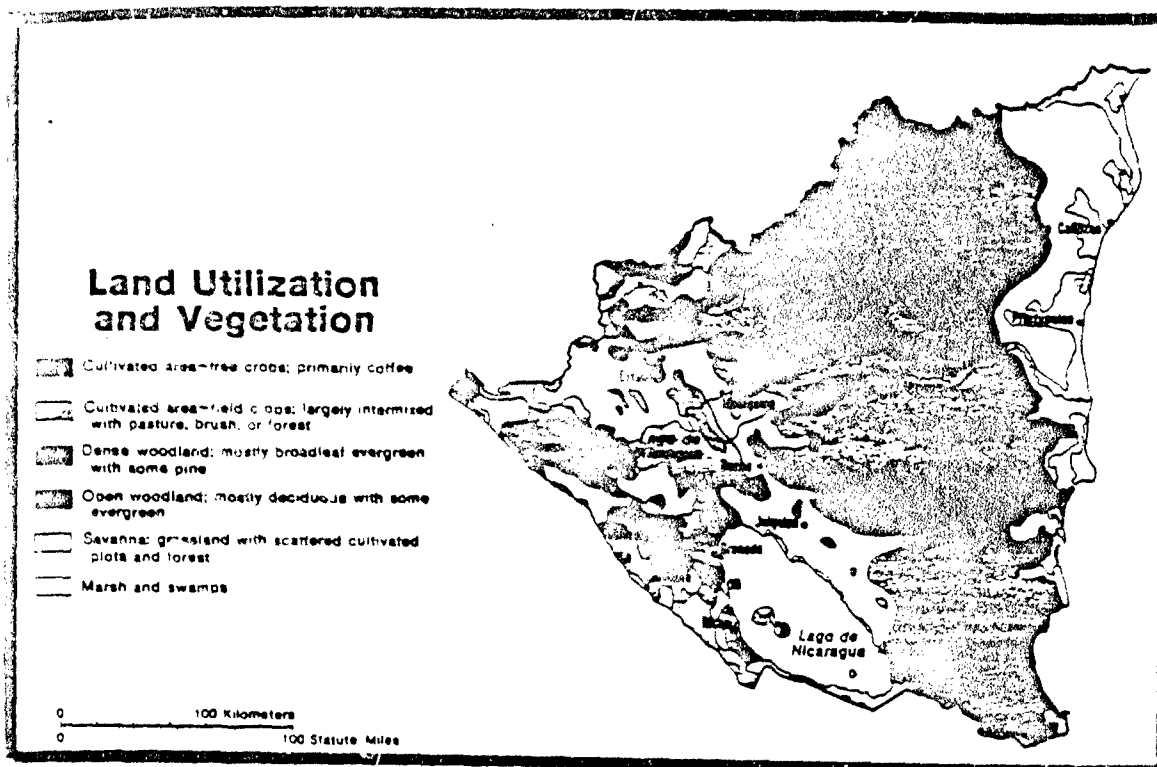
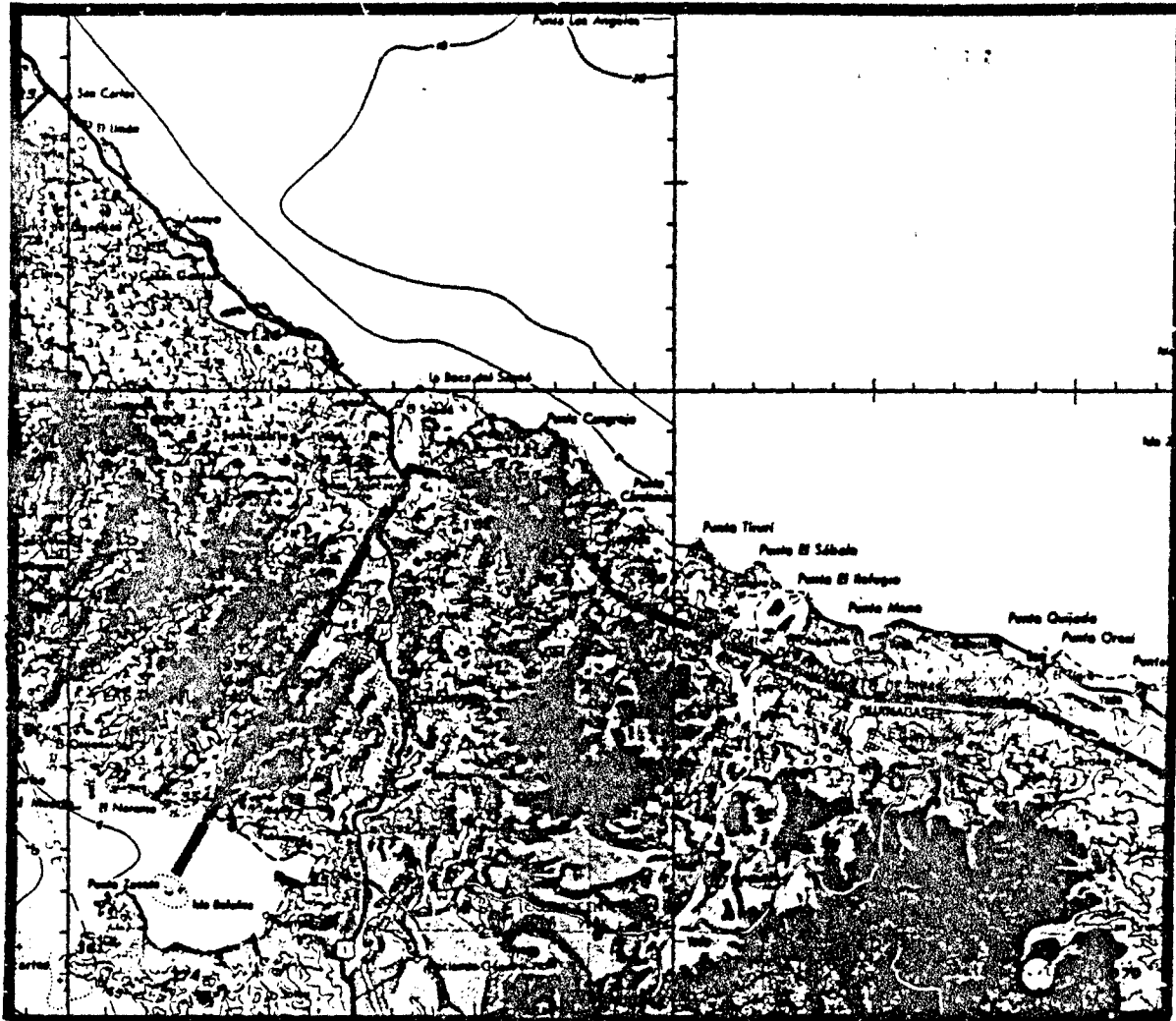


Figure 15. Land Utilization In Nicaragua (From Map Series CIA, 504012, 1079 (544374))



MAP 1

The data for this map was compiled in 1972. The terrain is mostly a combination of open woodland mixed with savanna and a few cultivated areas. Marsh and swamp land predominate the southeastern portion of the Lago de Nicaragua.

III. SCENARIO

This section has two parts. The first portion concerns the strategic and operational objective of the scenario. The second portion is the tactical concept of operations of the contrived scenario.

A. Strategic and Operational Overview

Nicaragua has attacked south and has crossed the border of Costa Rica. The Nicaraguan invasion of Costa Rica with Cuban support threatens one survival and six vital interests of the United States. The threatened U.S. survival interest is a secure "back yard" which is a geographic-strategic resource. The six vital interests are:

1. The intervention and influence of Cuban and Soviet hostile forces.
2. The unrestricted passage through sea and air lanes of communication surrounding Central America and continued access to the Panama Canal.
3. The desirability of a politically stable region, free from internal conflict and intraregional strife.

4. The unrestricted access to raw materials in the region, especially gas and oil fields.
5. The uncontrolled illegal immigration into the United States.
6. The illegal drug trafficking into the United States.

There are seven assumptions that form the basis for this scenario. The key assumption that is that the United Soviet Socialist Republic (USSR) will not become directly involved in this conflict unless the U.S. were to invade Cuba. The second assumption is that the government of Costa Rica will ask for the Organization of American States (OAS) intervention on their behalf and the United States will introduce combat troops on their soil to protect the sovereignty of Costa Rica. Thirdly, these U.S. combat forces could conduct operations from secure bases in El Salvador, Honduras and Panama. Fourthly, the majority of members in the OAS will support intervention by forces of the United States. The fifth assumption is the U.S. Government will agree to intervene and Congress will support this action within the limitations of the War Powers Act. Assumption number six is that theater nuclear forces will play no part in this conflict. The final assumption is the U.S. is not involved in any other hostilities.

The theater immediate military objectives are to end the invasion and restore the territorial integrity of Costa Rica and to neutralize Nicaragua as a base for any future military activity in the region. The longer term military

and political objectives are to restore and maintain democratic principles in the area and foster peaceful relations amongst the countries within the region. Accomplishing the latter will lead to a lessening of illegal immigration from this region to the United States and assist in stemming the flow of illegal drugs from this region into the United States. The overall objective is to restore the stability of this region so as to maintain a geopolitical secure United States' "back yard".

The military strategic concepts for this theater will be accomplished in three phases. CINCSOUTH will control all phases of this operation. During the first phase, it will be necessary to immediately place U.S. forces in Costa Rica to conduct economy of force operations since this country lacks a standing army. The U.S. Air Force will assist in achieving air superiority in the area of operations and naval forces will begin a naval blockade of Nicaragua. When adequate forces arrive in theater, phase two will begin.

Phase two is a ground offensive within Costa Rica and air and SOF operations within Nicaragua. Also during this phase, the complete land, sea and air blockade of Nicaragua will be completed. No operations will be conducted in Cuban territory; however, any Cuban forces within Nicaragua or attempting to violate the blockade will be attacked.

Finally, in the third phase, selected offensive land, sea and air operations will be conducted within Nicaragua,

in conjunction with the continuation of the blockade. This action will force the surrender of all hostile forces and the replacement of the current government with a freely elected government.

Resources required in phase one of the operation are two Light Infantry Division Increments (DI), one SOF Group and one air wing immediately. To insert the two DI's requires one strategic airlift. One Carrier Battle Group (CVBG) will be used in phase one to support land forces and begin blockade operations. One Marine Amphibious Force (MAF) supported by the necessary Amphibious Ready Groups will commence operations early in Phase one. Additionally, air assets committed in the same phase will include two additional air wings and three tactical airlift squadrons. Additional ground forces will include nondivisional combat increments (NDCI) and tactical support increments (TSI) to support the DI's.

Phase two will include a second SOF Group, a Mechanized DI and an Air Assault DI with appropriate NDCI and TSI. Special Purpose and Tanker/Cargo assets and one additional air-wing augments the air assets during this phase. In Phase two, a second CVBG will be required. Underway Replenishment Groups augments the naval forces. During phase two, convoy and sea lift operations will commence.

To successfully complete phase three, one additional DI may be necessary and will require continuing resourcing.

This third phase operation must be completed within 90 days so as to comply with the War Powers Act. 2

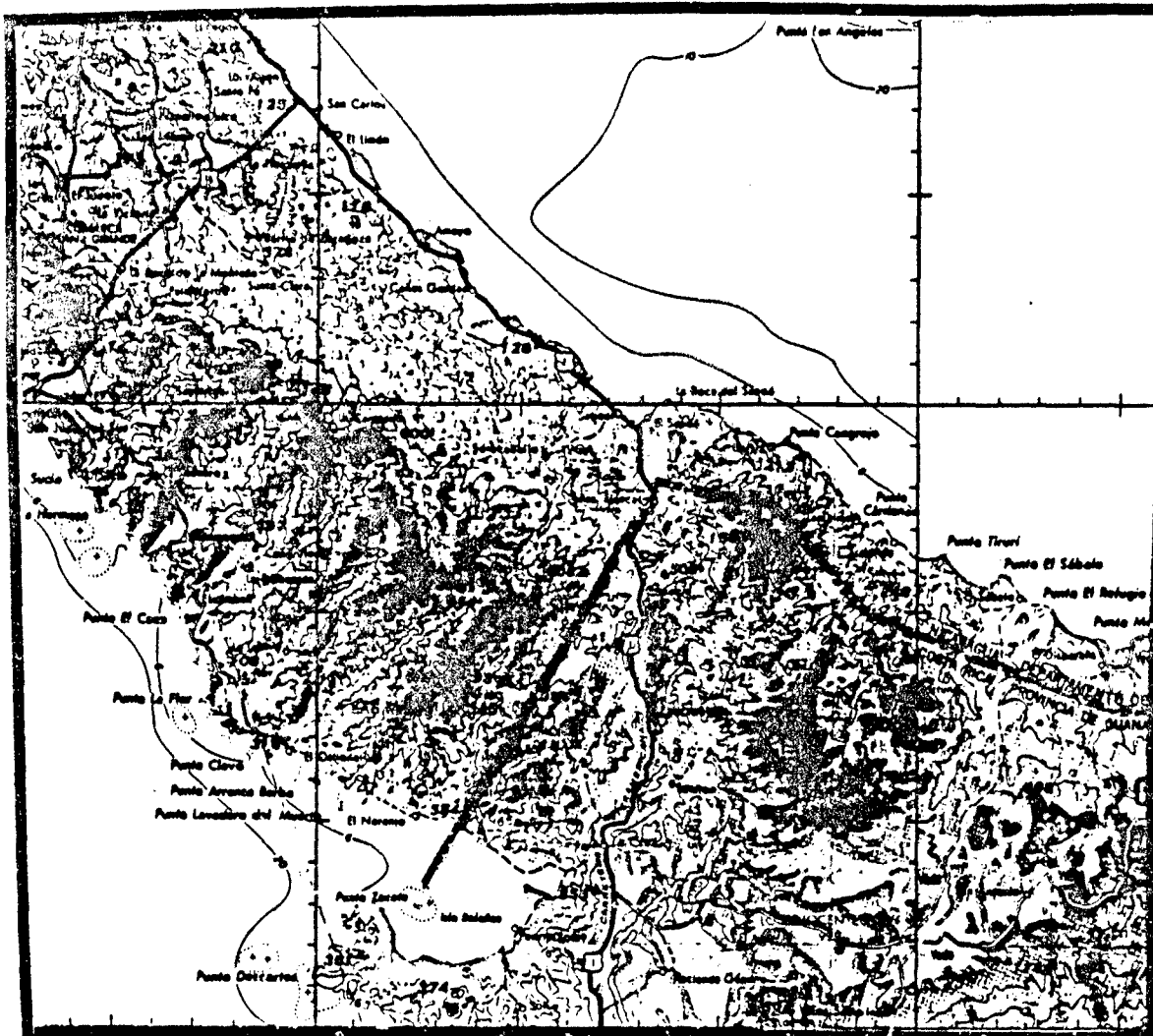
B. Tactical Employment

1. Concept of Operations

In the scenario area, the United State's committed forces are two light divisions and a MAF with its naval support off the Pacific coast. The concept of operations is to establish two separate division airheads with a subsequent offensive maneuver to not only restore the original border of Costa Rica but also to advance on the southwestern side of Lago de Nicaragua to Route 16. Route 16 is seen as a natural demarcation line. The MAGTAF would conduct an amphibious assault into San Juan del Sur to secure a beach head. The beach head is a circular area stretching from the town of Agua to the western slope of Cerro La Cuesta, then back along Route 16 to the port city of El Suero.

The general concept of maneuver for Division A will be to establish an airhead at Los Inocentes, Costa Rica. Division B will establish a similar airhead at Brasilia, Costa Rica. Maps 1 and 2 show the general area of operations.

Division A will conduct a two Brigade air assault operation into the town of Sapoa, Nicaragua. Once Division



MAP 2

A consolidates then they will continue to move north on Highway 1.

Division B will conduct a Brigade size airmobile into the town of El Tigre, Nicaragua and simultaneously conduct a ground operation north along the general axis toward La Virgen and Sardina in Nicaragua. Once Division B has linked up its elements at the Lago de Nicaragua, they will conduct a general northward advance to Sapoá. The planned amphibious assault will only be conducted if more ground support is needed to seize Sapoá.

On the east side of the Lago de Nicaragua, a similar sized joint force, composed of police forces from Costa Rica, a United Nations contingent and the United States, is attacking the Nicaraguan forces. They are engaged in an effort to seize the province of Rio San Juan and occupy the cities of San Carlos and San Juan del Norte (See Figure 16) for the total force's planned limits of advance.

This study will follow a Battalion Task Force from Division B into the airhead at Brasilia, Costa Rica, the landing zone in El Tigre, Nicaragua, the river crossing operation of Rio Oro, and the offensive maneuver as the unit moves towards the airfield at El Sapoá from El Tigre. Now, we will leave the background information and die into the scenario.



Figure 16. Limit Of Advance (From Nicaragua: The First Five Years, 1985, cover page)

2. Division A

D-2

COMMANDER'S INTENT- CDR, 1st Bde, Div A - To fully prepare the individual soldier, in the basic MOS related skills, for combat in a low to mid-intensity battlefield.

COMMANDER'S INTENT- CDR, 1st Bn, 1st Bde, Div A - To pool battalion's assets and set up a round robin Common Skills Testing Site based on Skill Qualification Test Level 1 of the 11B and 11C job specialties. E-5s or promotable E-4s

run the test stations with senior NCO's supervising the orderly movement of soldiers through each station.

EN S-3, 1st Bn- TRAINING GUIDANCE - Obviously, because of training resource constraints the only NBC station will be donning the mask and a timed test of the soldier's ability to go from MOPP Zero to MOPP 4. The only communication station will be how to place in operation an AN/PRC 77 radio. Personnel will first zero and qualify on their assigned individual weapon before going to the skills testing site.

EN S-3 (2130 HRS, D-2)

Dear Diary,

Well the ranges were set up and most of the soldiers (60%) obtained an acceptable shot group and qualified with their weapons. The Common Skills Testing (CTT) stations were not ready for business until 1400 Hours. I hope the boss will continue the CTT Testing tomorrow and up until we deploy. EDRE procedures went without a hitch. I feel confident that all the personnel data on each soldier is correct.

2330 HRS, D-2

INTEL MESSAGE #1

FROM DIVISON S-2 to Bde S-2

1. Satellite photos indicate an unusual amount of chemical agents being stockpiled in Nicaragua. These are based in close proximity to the Lago De Nicaragua.

BDE SDNCO logged this message delivered by Division courier while the BDE SDO was out inspecting motor pool security.

D-1

0500 Hrs.

BN HQ

BN CDRS guidance at Staff Meeting- Complete weapons qualification by 1300 Hours, continue skills testing until 2000 Hours. Be prepared to issue FRAGO to Deployment Order by 0630 Hours.

0630 Hrs.

FRAGO #1

TO: ALL BN UNITS

1. No change to movement plan. We will be the first full battalion on the ground at LOS INOCENTES. We will secure the portion of the BDE perimeter from the southeastern VALDO

(fording site) to the road leading to FINCA SANTA INES. Company A will secure the ford site, Company B will block the Ines Road, and Company C will occupy the center of the sector. As per Battalion SOP rucksacks will be dropped at the airfield and brought up later. All will carry protective masks.

2. Offload at LOS INOCENTES will be administrative. Have unit's basic load close at hand just in case.

3. 1st Chalk (Company A) will be ready to load trucks by 0100 Hrs D Day.

0800 Hrs

Bn Training Officer Evaluation

SKILLS TESTING SITE- Too much standing around and wasting of time. A definite lack of urgency is being exhibited by all personnel at the test site. No platoon leaders or commanders present. Observed several soldiers passing stations when in my opinion they should have received NO GOs.

1500 Hrs

Bn Training Officer Evaluation

M16 Range- The safety NCO's are firing the weapons of the last 5 soldiers- so as to comply to CDRS guidance. These soldiers have been here trying to qualify for the last

two days. This will complete all weapons qualification.
Range will be closed by 1515 Hours.

2330 Hrs

BDE Sergeant Major-BDE HQ

The Sergeant Major is at his desk finishing up his paperwork. He notes the message attached to yesterday's SDNCO log and, since the S-2 hadn't mentioned it at the morning staff meeting he automatically assumed it was not important. He next initials the log and places it in his OUTBOX for filing by the S-1 NCO.

2345 Hrs

Bn S-3

Dear Diary,

Couldn't sleep, so I am writing. Old man wasn't happy with minimal participation and lack of enthusiasm with Skills testing. Talked with Battalion Sergeant Major-- he says NCOs are still burnt out from maneuvers last week at Fort Chaffe, Arkansas. He says they are eager to cut the train-up and shoot real bullets at a real enemy. My gut feeling is that we are a solid unit and will have no major problems with this operation.

D DAY

Bn S-3 (0230 Hrs)

SPOT REPORT LOAD OUT

All is going right on schedule. For once all the C130's and C141's are on time and operational. Aircraft wheels up time is as scheduled. See you in LOS INOCENTES, COSTA RICA.

1030 Hours

COMMANDER'S INTENT-(1st BN, 1st Bde, Div A)- Secure the perimeter and have rucksacks with troops before 1730 Hours. VALDO is a small fording site so it should not take long to clear.

BN S-3 (1700 Hours)

SPOT REPORT Airfield

All aircraft, personnel, and equipment are accounted for. BN TAC at the VALDO, BN TOC at southwestern end of airfield.

1705 Hours

1st Squad, 1st Platoon, Company A (On Ines Road)

Squad leader looks back at First Fire Team leader after hearing an explosion. His right leg is gone. Squad leader yells to freeze. PVT Smith runs towards his friend and another small explosion is heard, but this time it sounds

more like a small firecracker accompanied by a hissing, like air is escaping. Smith is down holding his foot, but all of a sudden he gasps for air, runs around like a maniac and falls to the ground in convulsions. After observing PVT Smith, the squad leader gives the command to mask.

1707 Hours

1st Platoon Leader, Company A

The LT sees the situation and has his platoon mask. Then he gives his 2nd Squad Leader the mission of clearing a path to the stranded First Squad. Platoon Leader tries to yell and be understood by 1st Squad Leader. That squad leader, totally frustrated at the incomprehensible exchange, attempts to move to his injured fire team leader. That squad leader trips a trigger and an antipersonnel (Claymore) type mine riddles him with shot. Lieutenant removes mask and commands all the soldiers from 1st Squad to stand fast. He then replaces his mask.

1710 Hours

1st Platoon Leader, CO A to the Radio Telephone Operator (RTO)

Contact CO and tell him we have encountered a combination chemical and high explosive mine field. Tell him three casualties and request NBC NCO to me.

After four tries at verbal communication-Lieutenant writes message on notebook and gives note to RTO.

1725 Hours

RTD to CDR Company A

After five tries, message received and understood. NBC
NCO on the way.

1735 Hours

RTD CO A to BN TAC

In vicinity Ines Road, 3 casualties due to land mines.
Possible combination chemical and high explosive mix.
Request Engineer support to clear road.

1745 Hours

The 2nd Squad, probing with bayonets, reaches last member of
the 1st Squad.

1845 Hours

All members of the squad are off the road and are being
examined by medical personnel. They will be evacuated back
to airfield. It is confirmed that the one soldier who went
crazy exhibited all the symptoms of ingesting VX.

1900 Hours

Rucksacks have been delivered to each company unit.

1945 Hours

BN CDR to BDE TAC

Perimeter is secured with minor casualties. All units are now in MOPP Zero.

2130 Hours

BN S-3

Dear Diary,

Up until today I always equated use of chemicals to the boogeyman in children nightmares. The body of that soldier cannot even be carried home until it is decontaminated. We have made a mistake of underestimating the enemy. MOPP 4 might become a constant way of life here.

2350 Hours

In the skies over EL SAPCA

The pathfinder group leader gets the green light and he and his four man team exit the aircraft. He goes over his mission one more time as he HALOs into the selected drop zone. In five hours he must properly mark the DZ and set the radar beacon out so the nine C130 aircraft can drop their two company load of paratroopers at the airport at EL SAPCA. These troops will secure the airfield and hold a tight perimeter to allow a two brigade force to air land. As he nears the ground, he notices the lack of activity, in

fact, there is no one around. As he executes his PLF, he notices a heavy dew on the ground.

D+1

0200 Hours

EL SAPCA

DZ is setup. The members of the pathfinder team note burns on all exposed skin. Also, those that have rubbed their eyes have an intense burning pain in their eyes.

0205 Hours

PATHFINDER LDR to DIV TAC

DZ is prepared. Chemical agent on DZ-possible HD- no enemy activity or life on DZ. Two casualties. No overgarments on hand. Team has masked. OUT.

Message was repeated ten times before it was understood at the TAC.

0300 Hours

LOS INOCENTES DIV TAC

DIV COMMANDERS INTENT - Airborne drop is scrubbed. Will conduct an airmobile instead and land airborne troops at LOS

INOCENTES. Airmobile will consist of 1st Brigade. PZ is here, kick off time is 0600 Hours.

FRAGO 2

1st BDE to BN UNITS

1. Liftoff from PZ 0600 Hours D+1. PZ is LOS INOCENTES. Possible Blister agent on LZ. MOPP 4 is uniform. Expect HOT LZ. Only friendlies on LZ is five man pathfinder unit.
2. Six ship lift using UH60. Inform this HQ how many lifts are required NLT 0400.
3. SECURE LZ, SURVEY LZ AND CLEAR CHEMICAL if possible. As soon as you clear, we will air land other BDE.

0330 HRS

TAC

Cdr, 1st BN

COMMANDER'S INTENT- We will secure LZ in MOPP4. Do not don MOPP4 until in position at PZ. Chemical Officer will organize HHC survey team. All units, be prepared for hasty decon techniques, NBC Reports, and survey techniques.

0430 HRS

ISSUE BN FRAGO

FRAGO A

1st BN to Units

1. Cancel ground attack plan.
2. Airmobile operation. PZ liftoff 0600 HRS. Six Ship PZ/LZ/Eight PAX per load. PZ is LOS INOCENTES. 0510 HRS move out to PZ. Secure PZ as per BN TAC SOP.
3. Order of movement same as original attack plan. BN CMD Group on #2 ship/#2 Lift. Each unit allotted four lifts. Only friendlies on LZ is a five man pathfinder team.
4. MOPP4 will be worn. Suspected blister agent on LZ.

0445 HRS

TAC

1st Bn S-3

Dear Diary,

This is going to be a zoo. Not only do we have to hip-shoot a battalion airmobile, but we have to do it in MOPP4. The limitations we have are: (1) we don't have room to carry any water except two canteens per man, (2) this blasted heat and humidity, (3) no projected personnel replacements, and (4) everyone will be scared to

death of the chemical agent. I know AirLand battle doctrine says we must be flexible-but it doesn't say we have to go against a stacked deck.

0600 HRS.

SPOT REPORT (BN S-3 Air to BN TAC)

First lift of UH60's leaving as scheduled. Second lift on ground loading.

0610 HRS

BN CDR to RTO

I can't believe how much I have sweated just walking to this helo.

He repeated comment four times before RTO understood.

0830 HRS

SPOT REPORT (BN TAC to BDE)

No resistance at LZ. Perimeter is 60% complete. Pathfinder team are all incapacitated, need medical evacuation ASAP. Request unit chemical alarms be brought forward ASAP. Need water resupply ASAP.

The message took over 15 minutes to send.

0930 HRS

SPOT REPORT (BN TAC to BDE)

Do not need retrans helo anymore. Antenna set up and functional. Three casualties all due to falling over or hitting objects while in MOPP4. Blister agent has been dissipated due to morning rains. Agent has polluted all water sources in this area. Now in MOPP3. Need ARTY ASAP- begin AIRLAND.

1000 HRS

DISCOM SPO (LOS INOCENTES)

I hope that Battalion appreciates the work my guys did to purge those three mogas blivots, fill them with water, and then sling them under those helos. I will probably never see that sling equipment again. Nothing like innovative logistics.

1005 HRS

SPCT REPORT (CDR COMPANY A to BN TAC)

Incoming Artillery. Combination of light missile and heavy stuff. At least 8-inch. FIST chief cannot contact his Bn. Request counterbattery.

1010 HRS

1st PLT, Company A to PSG

CHECK the positions. See if we have anyone hurt.

1020 HRS

2nd SQD Ldr sees PSG coming. He meets him and walks him down the perimeter. PVT Jones and Hale in one foxhole seem to be asleep. So, Squad leader attempts to wake them up. He notices a bluish tinge. They are not breathing. PSG notices a enemy shell that did not totally explode. PSG gives order to mask. PSG sends runner to get PLT Leader.

1030 HRS

Runner informs PLT Leader. Lieutenant gives order for platoon to assume MOPP4. He tells RTO to contact TAC and inform them of two casualties and that the platoon is in MOPP4.

1040 HRS

PLT leader arrives with 2nd Squad leader and PSG. PSG points out to LT both dead soldiers have pinpointing of pupils and some salivation from their mouths. Could be symptoms of a nerve agent. LT orders to bag and isolate the bodies which will be evacuated ASAP. He tells PSG he will hold a meeting of the squad leaders. PSG relays information by placing his voice emitter against the platoon leaders ear and speaks one word at a time very slowly.

1050 HRS

RT0 gives up attempting to relay 1005 spot report message with mask on- He takes mask off, sends message, then replaces mask.

1100 HRS

1st PLT Ldr to Company CP

The platoon leader sends his RT0 as a runner with a written message.

Have four casualties. Seem to have resulted during bombardment from a nerve agent. We are in MOPP4. Request evacuation of four soldiers.

1105 HRS

1st PLT CP

The LT is talking too fast and excitedly to be fully understood by all the squad leaders and the platoon sergeant. Finally, this realization hits the LT. He stops talking and writes a short message on a piece of notebook paper. The first one he writes states, "SOP in MOPP4 is to use hand and arm signals or communicate by messenger." After a few more such messages and written questions by squad leaders the group session is over.

1105 HRS

TAC to All units

Return to MOPP4. Chemical alarms are here. Pickup ASAP and place in operation in center of your perimeter. During every future artillery barrage assume MOPP4.

1110 HRS

BN TAC to BDE TAC

During last artillery barrage suffered four casualties due to nerve agent. Am in MOPP4 and surveying area. Evacuating casualties to LOS INOCENTES to your S-1. The body bags are contaminated.

1300 HRS

1st BN S-3

Dear Diary,

I have never tried to operate in MOPP4 this long. It is like putting the TAC in slow motion, but still being required to function at a double-time pace. Thank goodness we haven't had any major offensive actions launched against us. We can't even understand simple radio transmissions. We are in the messenger mode. We probably need carrier pigeons. The amount of water consumption is incredible. The fatigue factor is scary. I am glad our company commanders are young and in good physical shape. The SMAJ was one of our first heat casualties. He refused

to drink water or slow down. The old man is really hurting, but at least he has paced himself.

D+2

0100 HRS

BDE TO DIV TAC

EL SAPOA is secured, all troops and equipment in place. We are hardening defensive positions. Have returned to MOPP ZERO. Need water ASAP. Have suffered 50 heat casualties, four chemical casualties, 25 noncombat injuries since leaving LOS INOCENTES.

0300 HRS

Situational Report: EL SAPOA-airfield

Two large explosions, occurring moments apart, breaks the silence. The hangar on the southwest side of the runway is a ball of flame and there is a rather large hole in the middle of the runway. The platoon that was asleep in the hangar never had a chance to move. One Stinger team near the runway crater begins to experience a tightness in their chests and very quickly fall to the ground in convulsions. A truck driver seeing this begins the gas alarm.

This concludes the scenario for Division A. Next we will follow Division B through a mission in the same area of operations.

3. Division B

COMMANDER'S INTENT - (2nd BDE, DIV B) - To be ready to conduct limited visibility operations on a chemical, mid-intensity battlefield. This means to not lose or interrupt the combat tempo because of MOPP4 and to be able to outguess and outperform the enemy on a "dirty" battlefield.

COMMANDER'S INTENT - (2nd Btn, 2nd Bde, DIV B) - To quickly train all personnel to SGT Level 1 Standard on: (1) NBC masking procedures, (2) wearing the overgarment, (3) crew and individual decontamination techniques, (4) hand and arm signals, (5) marking contaminated areas, (6) the proper wear and fit of all NBC equipment, and (7) maintenance and operation of the unit NBC alarm. cursory check of weapons since we just returned from an intense two-week training period of weapon's proficiency.

D-2

0545 HRS

BN S-3 at AM Command and Staff Meeting

The key to achieving what the old man wants is to maintain unit integrity (from squad to company levels) during all phases of the training. Each unit Chemical NCO and Officer will be OPCON to the BN Chemical Officer to set up, supervise and monitor the quality of the NBC training. Squads and Platoons will go through as one group.

1330 HRS

ASST 2nd BN S-3 Spot Report on NBC Training

Everyone really seems to be getting into the training. The test committee seem to be a tough group. The standards here seem to be higher then during EIB training. All soldiers are being tested properly- even the senior NCO's and officers are here being tested. The control seems good and when a squad is waiting to be tested they are practicing communicating in MOPP4 since they are not allowed to remove their masks. Because of the detail and the high first time NO GO rate, training will need to continue tomorrow.

2200 HRS

2nd BN S-3

Dear Diary,

I am sure the old man is as impressed as I am about the attitude and eagerness of the battalion to master NBC skills. The soldiers seem to view this as the only barrier standing between us and the enemy. Instead of a fear of chemicals, the men have a feeling of being able to overcome anything with the proper training. I am not sure the boss can hold this battalion down until D-day. Now I understand why the boss has been pushing realism in NBC training (for the last eight months).

2330 HRS

2nd BN HQ

The BN CDR has just been hand-carried a message from Brigade. This confirms that Nicaraguan forces will use chemicals against us, especially to stop any invasion of their homeland. The Commander is meeting with the company commanders and the S-3 to make sure they understand the consequences and criticality of chemical training before deployment. He wants PT to be done in MOPP4 tomorrow. Everyone will do individual warmups and then assemble on the helipad for a battalion three-mile run in MOPP4.

D-1

0600 HOURS, BN Area

TEMPERATURE-77 degrees F

No Wind

The companies are conducting a uniform 15-minute warmup period before the battalion run. MOPP4 will be worn for the warmup phase. The Battalion Commander plans to address the troops before the run, while in MOPP4.

0630 HOURS

BN Assembled on helipad

Commander speaks extremely slowly--stressing one word at a time through his mask. As a First Sergeant in the rear of one company formation, I am amazed I could understand him. The Commander states, "Communication is not a problem if one speaks slowly, distinctly, and loudly. Good luck on the run. It will be nothing compared to the weather in Nicaragua."

0800 HOURS

BN CDR Review of Troops after run. (Statement to S-3)

We lost about one-quarter of each unit. My point for this formation was to stress how hot MOPP4 is and that it is possible to effectively communicate with a protective mask

on. Also, we need to convince our troops that they can drink water while wearing their masks.

0830 HOURS

Messenger delivers BDE FRAGO TO BN HQ

FRAGO 1

BDE to BN

1. No change in order of unit movement. 2nd BN is the first full combat element on the ground at BRASILIA, COSTA RICA. Secure portion of perimeter north of airfield from RIO LAS HACIENDAS to the crossing site at the town of SAN CRISTOBAL.

2. Have recieved no update on enemy chemical status. Per BDE SOP, rucksacks dropped at airfield until perimeter is secured. Protective masks will be carried.

3. Offload at BRASILIA is admin move. Have basic load on soldiers before arrival in country.

4. First chalk ready for loading out of company area 0100 Hours, D Day.

0845 HOURS

Messengers carry BN FRAGO to each company.

FRAGO A

BN HQ TO ALL COMPANY HQS

1. Order of movement per BN SOP. COMMAND GROUP will be with Company A, 4th Chalk. First unit load on trucks at 0100 Hours, D Day.
2. C130 loads will be combat loaded: ammo issued prior to boarding aircraft. No update to chemical situation. Protective masks will be carried. Per SOP, rucksacks dropped at designated site on LZ.
3. Secure river crossing site and town are key to mission.

0930 HOURS

BN S-3

Dear Diary,

Old man went nuts with FRAGO A. He is making units prepare for an assault landing in COSTA RICA. We must be in MOPP 1 when exiting the aircraft and be prepared to assume MOPP2 on order. This includes troop combat load-all soldiers with rucks close by sit on the aircraft floor and are held down by one long cargo strap. Boss even made soldiers run from the helipad to the NBC Chamber in MOPP4, in company formations, for the whole two miles.

1030 HOURS

BN S-3 Spot Report at NBC training site

Round robin training is going well. The station for self-decontamination is using ammonia tinged with garlic to simulate a blister agent. Platoon sergeants are learning how to use NBC report formats as well as operate a unit decontamination alarm. Flash cards were made to allow soldiers to know the different types of chemical agents, their effects, and symptoms. Squad and Platoon leaders are practicing hand and arm signals so their soldiers will still be able to perform battle drills while in MOPP4.

1130 HOURS

BN S-3 Spot Report at NDC Chamber

All filters are checked for serviceability as well as individual mask seals by unit NBC personnel. Soldiers are gaining confidence in their mask as well as their ability to perform while masked. Soldiers are hosed off before departing site to clean all the CS agent off their uniforms.

1500 HOURS

COMPANY HQ

Old Man called a meeting of commanders and reviewed with them basic NBC information. This included: (1) mental and physical limitations while in MOPP4, (2) symptoms of various chemical agents, (3) chemical reporting techniques.

He had the chemical officer review Soviet employment of chemicals. Then he had the S-3 as well as all the commanders see how quickly we could get into MOPP4. No one could leave his office until he had achieved the SQT standard.

1800 HOURS

BN S-3 Spot Report (BN SMAJ Meeting)

At a meeting of all unit First Sergeants the SMAJ detailed the chemical threat. Then he had each sergeant review one chemical agent. This review included: odor, effect on the body, persistency effect and its delivery means.

D DAY

0300 HOURS

SPOT REPORT- airfield

First aircraft loaded and wheels up heading for COSTA RICA. All equipment staged and ready to load.

0930 HOURS

SPOT REPORT- BRASILIA

The only unaccounted for unit is our towed artillery. Aircraft must have broken down and returned to Panama. The majority of our Brigade is on the ground with the next

Brigade closing in. Our battalion dropped its rucks and moved off towards SAN CRISTOBAL in good order.

1200 HOURS

BN S-3

DEAR DIARY,

On perimeter near SAN CRISTOBAL. Most soldiers, since they are still in MOPPI have sweated thru their overgarments and have drained both their canteens. Need to find the boss and convince him to go to MOPP ZERO. S-4 is not having much luck getting an emergency water resupply.

1230 HOURS

BN CDR to ALL UNITS

Go to MOPP ZERO.

1700 HOURS

BN S-3 SPOT REPORT

All organic and attached Battalion assets are on the ground. BN TOC is located on north end of airfield. Perimeter has been established from the RIO LOS HACIENDAS to the fording site at SAN CRISTOBAL. BN TAC is at fording site. Rucksacks have not been delivered yet.

1705 HOURS

BN TAC

Old man has departed to airfield for BDE CDRS meeting. Executive Officer is running down rucksacks at airfield or is at the TOC. BN S-3 is the senior man at the TAC until return of Commander.

1735 HOURS

SPOT REPORT (2nd PLT to C CO CDR)

Five HIND D helicopters approaching from the NORTH are engaging. Request additional ADA support. Flying low and slow trailing white smoke at this time. Have moved my CP to lead OP to observe better.

1740 HOURS

SPOT REPORT (C CO. to TAC)

Five HIND D helicopters approaching from the NORTH. Our ADA assets are engaging. They are flying low and slow, paralleling the perimeter.

1750 HOURS

SPOT REPORT (C CO. to TAC)

ADA must have hit all five because all are trailing a white smoke. Only two have crashed. Smoke cloud is blowing our way and is now over 2nd PLT.

1755 HOURS

TAC to all units

Assume MOPP4 now. Suspected chemical vapor attack.

1757 HOURS

SPOT REPORT (C CO 1SG to TAC)

Chemical alarm has sounded. No contact with 2nd PLT or OP. Cloud has settled in on 2nd PLT. Have assumed MOPP4.

1800 HOURS

SPOT REPORT (2nd PLT)

Platoon RTO comes staggering from general direction of OP. RTO does not respond to the yelling or the PSG. PSG runs after RTO and tackles him. As he tackles him PSGs protective mask gets knocked off. PSG immediately smells garlic odor and replaces as well as clears his mask as he is sitting on the RTO. PSG notes the soldiers eyes are swollen closed and he has blisters on hands and face. RTO yells that he is blind. PSG yells for medic and hands soldier over to him.

Next PSG leaves squad leader in charge and grabs two soldiers and moves out toward OP. All three men see the Platoon Leader about the same time. His face is blue, at least that part that is not covered by blisters. The other two soldiers in the OP are not dead but are barely

breathing. Both soldiers are in about the same condition as the Platoon Leader.

PSG sends one man to get the medic and tell Company CP that they have four casualties, one is the LT. Also, stress that they have survived a blister agent attack.

1810 HRS

C COMPANY OP

Medic arrives, says there is nothing he can do to help the two soldiers. One of the two has already died. They will try to evacuate the other soldier ASAP.

1830 HRS

C COMPANY to BN TAC

Suspected aircraft smoke vapor chemical attack.
Suspected chemical is a blister agent. Two wounded, three dead. 2LT Smith is among dead.

1835 HRS

BN TAC to C Company

Sending Chemical Officer, additional medics and survey team to your location to mark contaminated area and classify agent. Hold present position.

1900 HRS

FRAGO 2

BDE TAC to all units

1. SOF A Team inserted and will prepare LZ southwest of EL TIGRE, NICARAGUA. You will be relieved in place by sister battalion NLT 0530 HR, D+1. Unit will be on runway at BRASILIA, NLT 0900 HR, D+1, ready for combat assault into EL TIGRE.

2. Only friendlies will be four man A Team on LZ. Mission is to secure portion of road between EL TIGRE and SARDINA. On order, be prepared to move north on road to SAPOA.

3. You will be portion of two brigade airmobile into area. NBC Uniform will be MOPP ZERO. Send runner to pickup Operations Order ASAP at BDE TAC.

2100 HRS

SPOT REPORT - B Company to TAC

Perimeter probed by small arms fire. Seems like only harassment.

2130 HRS

FRAGO B

BN TAC to all units

1. MOPP reduced to MOPP0.
2. 50% manning requirement for force until 100% Stand to at 0500 Hours.
3. Commanders report to TAC for airmobile OPLAN.

2200 HRS

BN S-3

Dear Diary,

Thank goodness the chemical attacks have been small in scale. I hate to think that we could have lost a whole platoon or company in just one surprise attack. I wish I could have taken a picture of the paper, candy and other junk that fell out of one soldier's protective mask carrier which prevented him from getting masked until it was too late. Next time we will be ready for those spraying helicopters.

D+1

0500 HOURS

BN TAC

BN CDRS exchange handshakes and salutes. 2nd Battalion is on the road moving towards BRASILIA to play its role in the two brigade airmobile.

0900 HOURS

BN S-3 SPOT REPORT-BRASILIA

Operation going according to plan the battalion TAC moves out on next lift. Hope things are going as well at the other end.

1100 HOURS

BN S-3 SPOT REPORT -EL TIGRE

No resistance at LZ. SOF Team Leader has seen no human life in area since his arrival 10 Hours ago. Company A and B are clearing the town of EL TIGRE. Company C is setting up blocking position north of town.

1120 HOURS

1st SQD, 1st PLT Company A -EL TIGRE

As door of hut number 15 swings open, a massive concussion and burst of light knocks the body of a soldier back on the street and blinds his fire team leader. Someone yells, "This town is booby trapped."

Out of the fire ball that was a hut, exudes an odorless, colorless gas mixing with the smoke. Almost simultaneously, the remainder of 1st squad experiences a tightness in their chests and convulsions. The platoon leader, who is stunned, shakes it off and witnessing this scene, masks, and starts the gas alarm.

Most of second squad, who were across the narrow dirt street, exhibit the same symptoms and cannot physically make themselves mask. The 3rd Squad leader attempts to gain the attention of his squad, but they are masked and running to aide their fallen comrades. He manages to get the attention of the 1st fire team leader and says, "MOPP4!". 1st PLT Ldr gives the order to go to MOPP4.

1130 HOURS

SPOT REPORT-1st PLT to CDR CO A

Lost half my platoon to some type of chemical attack. We are in MOPP 4. Suggest all in area do same. (The RTO remembering the BN CDRS example a few days ago speaks one word at a time and completes the message the first time.)

1133 HOURS

SPOT REPORT- CDR CO A TO TAC

Heavy casualties in 1st PLT due to one large explosion in El TIGRE. Suspect chemical, am in MOPP4. Wind is blowing smoke towards COMPANY B.

1140 HOURS

NET CALL-TAC to all units (BEFORE RTO MASKS message is sent)

GO TO MOPP LEVEL 4 immediately. CO A regroup and move to northern portion of town. Give me update on casualties ASAP.

1150 HOURS

BN TAC to BDE TAC

Am in MOPP4. Unexplained explosion in EL TIGRE. Heavy casualties in Company C. Possible nerve agent attack. More to Follow. LZ should not be effected by EL TIGRE blast.

1151 HOURS

SPOT REPORT-EL TIGRE (1st PLT LDR to CDR CO A)

Two soldiers are in MOPP 4 at north end of street trying to talk to each other. Neither can understand the other. Both are just getting angry and yelling.

1st PLT PSG gains the attention of Commander and states it was one missile that blew hut apart. By drawing pictures in the dirt, the three communicated. PSG was holding a SCUD missile fragment. Conversation cut short by multiple screams piercing the air. A small caliber missile barrage has just started. All run for cover.

1159 HOURS

SPOT REPORT- CO C

SU25 Frogfoot aircraft approaches from the northwest. They fly over EL TIGRE and release a fog. Since there is not much wind, the vapor falls in EL Tigre and concentrates in the western part of town. Since the rocket barrage has stopped, the soldier's of COMPANY A and B are running for their lives, totally out of control, to the north to link up with Company C. The rocket barrage has damaged some soldier's overgarments and those caught in the vapor are now receiving burns on their exposed skin.

1200 HOURS

BN TAC-NET CALL TO ALL UNITS

All units join up with COMPANY C. CO A joins left flank of CO C and CO B forms right flank. Report linkup.

1300 HOURS

SPOT REPORT -CO C

The old man and I were helping stop the fleeing soldiers and placing them in positions around Company C and trying to identify the unit's chain of command. It was a next to impossible task since everyone was in MOPP Level 4. My assistant S-3 replaced the dead A Company CDR. There seems to be some semblance of control once again.

1320 HOURS

SPOT REPORT BN TAC to BDE TAC

All units in blocking position North of El Tigre and securing crossing site on the RIO OROS. Sustained heavy casualties due to massive chemical attack. Request a deliberate decon station be set up and medical support sent to my location ASAP. EL TIGRE is a contaminated area. All personnel keep clear.

1340 HOURS

BDE TAC to BN TAC

Give me your loss of combat power.

1530 HOURS

BN TAC to BDE TAC

Combat power follows- CO A 30%, CO B 60%, CO C 100%.
Overall 64%.

1630 HOURS

BDE TAC to BN TAC

Deliberate Decon will be set up in BRASILIA. Fall back to original LZ at EL TIGRE and other units will pass through you.

1700 HOURS

BN S-3

Dear Diary,

We never even saw the enemy, yet we have in essence lost 40% of our fighting strength. I guess we will become the replacements for the rest of the brigade. I never thought chemicals could be so awesome.

1800 HOURS

BDE TAC TO BN TAC

Essential you occupy north bank of RIO OROS NLT 1000 HOURS D+2. Inform this HQ when mission is complete. After analysis of chemical threat. MOPP level is now MOPP1.

1830 HOURS

BN S-3- RIO OROS

DEAR DIARY,

A leader's recon was planned, but as leaders passed last friendly OP they were fired upon by small arms. BN CDR conducted a map recon with commanders instead. We will have Air Force Close Air Support at first light as well as the division artillery on call. Commander reduced the MOPP level to MOPP 0 since most of our overgarments were torn and unserviceable. Still, the old man says we will be in MOPP4 for the attack. The intelligence reports indicate there are chemical mine fields protecting most river

crossing sites. There are two sites suitable for fording. After all, the road crossing is only a rock bottom portion of the river.

The river crossing plan is simple. COMPANY C crosses furthest from the Lago de Nicaragua, COMPANY B crosses at the road site and COMPANY A with all the COMBAT SUPPORT elements support by fire. Jump off is scheduled for 0700 HOURS. We have bangalore topedoes to aid in clearing paths thru the suspected mine fields. I find myself spending much more time reading and rereading the intelligence reports and having more difficulty writing and issuing orders.

1900 HOURS

FRAGO C

BN TAC to All Units

1. Intel picture is one of light and loosely organized resistance to our crossing. It looks like the enemy is stalling for time.
2. Uniform for crossing is MOPP ZERO but all NBC gear will be carried. We will have A10s for close air support at first light. Pass all requests to TACP with TAC.
3. TAC will be colocated with C COMPANY CDR.

D+2

0630 HRS

3rd Sqd, 3rd PLT, Co C

The squad leader completes a last minute MOPP4 and ammunition check. All seems in order. He is praying to himself that this is an easy operation since he knows after yesterday his squad doesn't have a whole lot more to give.

0700 HRS

3rd Sqd, 3rd PLT, CO C

Responds to order from Platoon Leader to move out. They move out in two loosely formed wedges. The squad leader hopes this is their last turn as point squad.

0730 HRS

3rd Sqd, 3rd PLT, CO C

As 3rd Squad nears crossing site they see smoke emanating from the opposite river bank. The smoke is blowing their way. The squad leader is leading the first wedge himself. He feels the hair on the back of his neck stand up as he nears the smoke. He takes a deep breathe and keeps moving.

As his wedge disappears in the smoke he breathes a sigh of relief because it is really just smoke. He stops at the river bank. The platoon leader will signal him when the

platoon base of fire is established and his first fire team can cross.

0745 HRS

3rd Sqd, 3rd PLT, CO C

The squad leader starts his crossing. Half way across the 50-yard river, his vision becomes blurred. He wipes the sweat off his face, but everything is still blurred. He signals double time and his wedge moves faster as the rest of his squad enters the river. As the squad leader reaches the far bank, he notices himself having difficulty breathing.

He notices another cylinder next to one of the smoke pots that was issuing smoke. He turns and notes the rest of his squad is halfway across. He opens his mouth, but instead of hearing his voice he hears incoming artillery and the world seems to suddenly disintegrate. He and another soldier are on the ground with convulsions.

The Platoon Leader and his RTO are in the water and moving with another squad as the artillery is coming in. The second fire team leader from 3rd Squad takes over and gives the command "GO TO MOPP4". Nobody could hear him because of the artillery, but those around him followed his example.

As the Platoon leader negotiates the bank he sees the squad leader and orders everyone to keep moving and

establish a defensive line 50 yards in. Once in position go to MOPP4.

0800 HOURS

1st Sqd, 3rd PLT, CO C

Artillery has stopped. It has pinned down the troops just long enough for all to have received a good dose of VX. Only the squad laying down the base of fire is not totally incapacitated. They were able to achieve MOPP4. They suffer from blurred vision, but none have experienced difficulty in breathing.

0802 HOURS

1st Sqd, CO C to CDR CO C

Heavy casualties due to artillery barrage, and chemical in smoke. Am in MOPP4. 2/3 of platoon combat ineffective.

0804 HOURS

CO C CP

RTO to commander. A broken and distorted communication from 3rd Platoon sounds like they are in trouble.

0805 HOURS

1st Sqd, CO C

Sent runner back to CP with written message stating: "PLT LDR dead, most of platoon across river and needs help, part of one squad is all that is left." As runner passes through 2nd PLT, whose platoon is in the smoke cloud, he

gives order to go to MOPP4. 2nd PLatoon halts and requests further orders from CDR C COMPANY.

0815 HOURS

CO C to TAC

Fording site is contaminated. Have injured soldiers on north bank. Am stopped on south bank awaiting orders. Crossing site has been attacked by artillery and possibly a nerve agent.

0830 HOURS

TAC to all units

Assume MOPP4. CO C return to position of Company A.

0831 HOURS

TAC to TACP

Need immediate air strike on hill north of Company C crossing site and friendlies are 100 yards north of river crossing site.

The team chief calls in mission before he masks. The CAS arrives and drop its munitions on empty jungle.

This concludes the scenario. Chapter 5 will tie specific scenario events to the lessons learned.

IV. ARTBASS APPLICABILITY

The ARTBASS model is one of the best current models for evaluating the role of chemical warfare on infantry operations. The following discussion evaluates ARTBASS applicability by explaining the purpose of the model, explaining how the model works, relating its shortcomings, and specifically describing how it analyzes communications.

ARTBASS (Army Training Battle Simulation System) is a computerized battalion level training simulation with an optional chemical warfare package. This system was fielded in 1984. The chemical module is capable of calculating environmental effects and providing casualty recommendation as well as contamination levels for personnel by posture and various MOPP levels.

This module can also provide immediate and residual chemical effects for a ground unit per play turn. The model's basis for generating effects is an analysis of the type of chemical agent employed, the agent dose used, the delivery method of the agent, and the type of conventional attack that is employed to cover the use of the agent. The personnel casualties are a function of the attacked unit location, the protection status of the attacked troops, and the strength of the chemical dose.

The model assumes 50% of all NBC overgarments will be worn properly. This means the one-half of all personnel in

the proper MOPP level will be assessed as casualties. When a persistent blister agent is used by an attacking force, 10% of the enemy will become delayed casualties. ARTBASS assumes 15-second minimum masking time and assesses a minimum of 10% casualty rate with every attack.

If an agent is deployed in a cloud, the standard figures for a downwind hazard are used. These figures are found in NATO Standardized Agreement 2103 (NBC). Hasty decontamination techniques take 60 minutes for each unit vehicle and 20 minutes for all the personnel of a company sized unit. Now that I have described the purpose and workings of ARTBASS, I will describe the effect on various unit missions.

The simulation degrades unit mobility and firing capabilities. The amount degraded is directly related to the type of agent used and the amount of time the unit remains at different MOPP levels. ARTBASS does not specifically degrade command and control of a unit. In fact, this simulation does not consider leader attrition, fatigue or communications. The specific degraded areas in this simulation are unit firing rates, target identification and engagement distances, and unit movement.

The TRADOC Analysis Command realizes these critical shortcomings and is writing VIC (Vector In Command) to replace ARTBASS. VIC is a new system with a chemical module that will consider the information outlined in Table 6.3

There is not a firm fielding date for VIC as of the writing of this thesis. The obvious conclusion is ARTBASS does an "average" job of preparing a leader to operate on a chemical battlefield. ARTBASS gives the leader a good idea

Table 6

VECTOR IN COMMAND (VIC) CHEMICAL MODULE

Persistent And Nonpersistent agents

Targeting (Predefined, Artillery Delivered)

Effects: Lethal impact area and downwind hazard area

Location Of Effects Considers:

- Temperature
- Wind speed and direction
- Air stability

Radius Of Effects Considers:

- Agent type
- Delivery system
- Number of rounds
- % lethality

MOPP Degradation Affects Unit:

- Movement
- Acquisition & Firing Rates
- Logistics
- Communication rates

of expected casualties, expected loss of mobility, and reduction of unit firing rates. ARTBASS does not consider or prepare a leader for the anticipated difficulty in command and control, leader attrition, and the expected communication difficulties on a chemical battlefield.

ENDNOTES FOR CHAPTER FOUR

¹Thomas W. Walker, Nicaragua The First Five Years, New York: Praeger Publishers, 1985: 11.

²General information for this portion of the scenario obtained from LTC Thomas L. Sickinger, CTAC, Fort Leavenworth, Kansas.

³Obtained from an 13 January 1988 interview with Mr. Steve Schorr head of the Combined Arms Tactical Training Simulator (CATTS), at Fort Leavenworth, Kansas.

CHAPTER 5

This chapter is not the end of my thesis question but only a lodgement from which to improve. Chapter 5 is divided into three separate sections. Part I is a succinct list of the "lessons learned". These "lessons learned" revolve around the expected communications difficulty that a light fighting force, operating on a chemical battlefield, would encounter. Part II is a cursory analysis of each lesson learned. This analysis will consist of the following sections: (1) identification of the lesson learned, (2) a list of experiments and studies that apply to the lesson, (3) an explanation of pertinent scenario events that reflect the lesson, and (4) a correlation section that relates the "lessons learned" to both the scenario events and other pertinent experiments and studies. For ease of scenario reference, the key communication events by Division A and B are listed respectively in Appendices A and B.

PART I -- LESSONS LEARNED

It is possible for a "Light Fighter" to communicate in a chemical environment. However, the degree to which the communication effort will succeed is directly related to how

well the following lessons are heeded. These lessons are categorized according to common features. The "lessons learned" are:

1. Communications suffer significantly in the chemical environment because of the following factors: (a) exhaustion of leaders, (b) leadership behavioral changes, and (c) the increased periods when no one is in charge.
2. Face-to-face communication is only one-half as effective in the chemical environment as in a no-threat environment and 38% of all radio messages must be repeated while in MOPP4.
3. Battalion TOC efficiency suffers significantly in a chemical environment because of the following: (a) written work and radio/telephone communications are subject to 40% more errors, (b) organic M51 Shelters cannot house a functional staff, and (c) more reliance is placed on gathering intelligence instead of planning for mission execution.
4. Opposed amphibious assaults by soldiers in a tropical environment wearing MOPP4 are judged medically impossible.
5. Training is the single most important factor in preparing to fight and win on a chemical battlefield.

PART II -- ANALYSIS OF LESSONS LEARNED

LESSON #1-- Communications suffer significantly in the chemical environment because of the following factors: (a) exhaustion of leaders, (b) leadership behavioral changes, and (c) the increased periods when no one is in charge.

A. Applicable Experiments/Studies

1. Tactical Air Control System Chemical Warfare Defense Equipment Task Validation, U.S. Air Force Tactical Air Warfare Center, March 1982.
2. Communication Behavior In The Organization, Charles E. Merrill Publishing Co, 1976.
3. Techniques For War Game Assessments Of Chemical Operations, Final Report Vol. 1, The BDM Corporation, 18 Sept. 1975.
4. The Effect Of Chemical Protective Clothing And Equipment On Combat Efficiency, U.S. Army Materiel Systems Analysis Activity, Nov. 1981.
5. A Study Of The Reaction Of Troops To Chemical Attack, U.S. Army Chemical School, 9 April 1962.
6. Final Report METOXE II Troop Test, 5th Infantry Division (MECH), 31 October 1969.
7. Endurance Of Overheated Men In Exhausting Work, Edgewood Arsenal, July 1968.
8. Mobility Through Contaminated Areas Test (MQCAT), U.S. Army Combat Developments Command, Jan. 1981.
9. Field Experiment Estimation Of Casualty Effects Due To Surprise Chemical Attack And Significance Of Protective Mask Leakage, U.S. Army Combat Developments Command, 25 Jan. 1963.
10. Force Development Testing And Experimentation Of Parachute Procedures In Chemically Contaminated Areas (PAPRICCA), U.S. Army Infantry Board, January 1981.

11. Combined Arms In A Nuclear/Chemical Environment Force Development Test (CANE FDTE I), Volumes I, II, III, U.S. Army Chemical School, January 1984.

12. Combined Arms In A Nuclear/Chemical Environment Force Development Test (CANE FDTE II), Volumes I, II, III, U.S. Army Chemical School, January 1986.

B. Scenario Application

<u>UNIT</u>	<u>DATE</u>	<u>TIME</u>
Division A	D + 1	0610
Division A	D + 1	1300
Division A	D + 2	0100
Division B	D - 1	0600
Division B	D Day	1100
Division B	D + 2	0730

C. Correlation

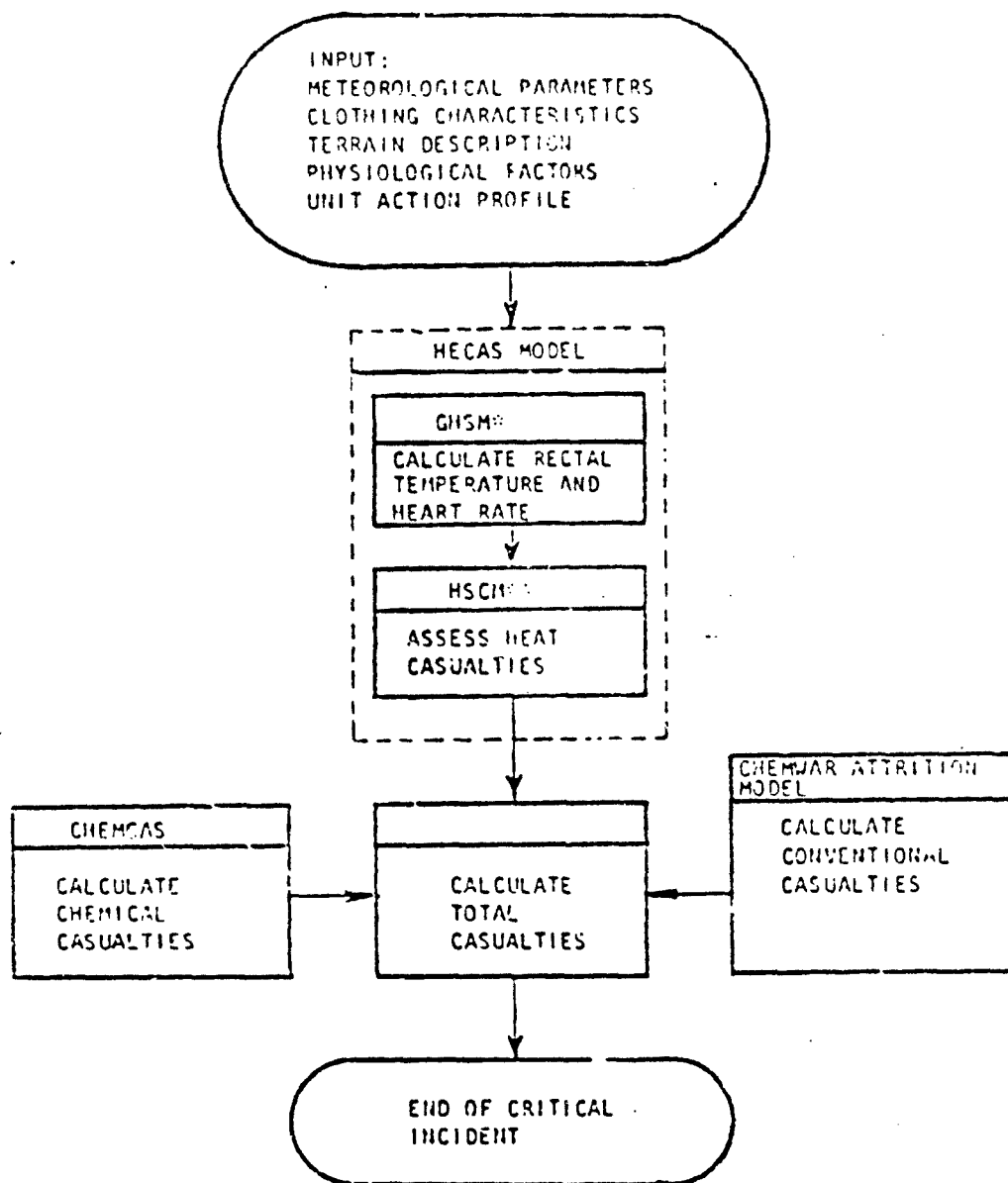
Several studies corroborate that as a person suffers from heat exhaustion, he will exhibit behavioral changes. First I will address heat exhaustion casualty projections. Then I will address leaders' behavioral changes and how they effect two key factors. These key factors are communications and movement of a dismounted force.

The BDM Corporation in 1975 developed the Chemical Casualty Assessment (CHEMCAS) model in an attempt to provide

sub-models for a unit defense sub-study. Specifically, the result was the Heat Casualty Assessment Model (HECAS) developed by combining data from the Goldman Heat Stress Model (GHSM) and results of field tests performed by the U.S. Army research Institute Of Environmental Medicine (ARIEM). 1

The HECAS Model predicts casualties due to the increase in the amount of heat stored in the body when chemical protective clothing is worn. The HECAS Model uses the GHSM to predict rectal temperature response to work, clothing, and environment. This data is then used to determine the amount of heat stored within the body. A pictorial description of the total process is shown in FIGURE 17.

The results are shown on the graph shown in FIGURE 18. This graph indicates that a soldier has a 60% chance of becoming a heat casualty when his rectal temperature reaches 104.2 degrees Fahrenheit. For example, the rectal temperature of a soldier participating in a 10-minute firefight and moving to a new firing position every 3 to 10 seconds would exceed 104.2-degrees in less than 15 minutes. In less than 15 minutes his rectal temperature will exceed 104.2 degrees. 2 The graph in Figure 18 indicates that the rectal temperature was only one degree off in relation to the clinical calculated casualty versus the actual field test.



* GHSM - Goldman Heat Stress Model

** HSCM - Heat Stress Casualty Model

Figure 17. Heat Casualty Assessment Model (From Techniques For War Game Assessments Of Chemical Operations, Final Report, Volume 1, 1975, pg. D-1)

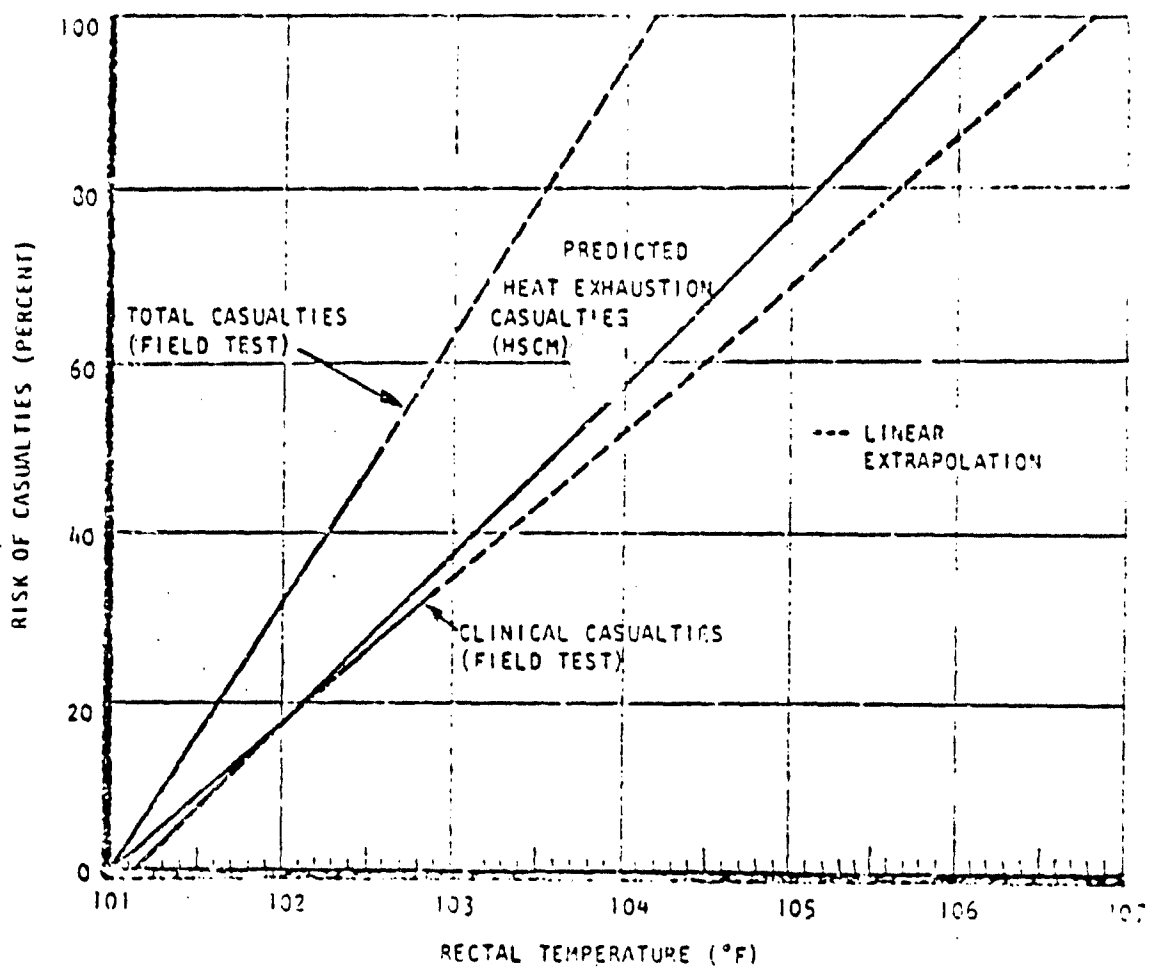


Figure D-9. Experimental and Predicted Casualty Risks.

Figure 18. HECAS Experimental Results (From Techniques For War Game Assessment Of Chemical Operations, Final Report, Volume I, 1975, pg. D-31)

The Craig and Froelich study agrees with the graph in Figure 18. This study brings to light that circulatory factors and availability of water play a larger role in the ability of soldiers to perform tasks while in MOPP4 than just rectal temperatures. 3

The Chemical Defence Experimental Establishment in Porton Down, Salisbury, Wilts conducted an experiment which expressed how long young men can work in varying temperatures. This experiment consisted of testing 19 physically fit men between the ages of 18.5 to 23.4 years. The subjects were exercised by having to walk on a treadmill, in MOPP4, in temperatures ranging from 15.2 to 40 degrees Centigrade (49.4 to 74.2 degrees Fahrenheit), and being stopped when their rectal temperature exceeded 39.5 degrees Centigrade (73.7 degrees Fahrenheit). TABLE 7 shows the results of this experiment. These same results are shown graphically in FIGURE 19. This would equate to a soldier in MOPP4 walking three miles per hour for 50.1 minutes over flat terrain in a 32.2-degree Centigrade environment before requiring a 10-minute rest.

It is medically documented that if a person approaches dehydration or exhaustion his behavior is affected. Again, the amount of behavior change that occurs varies between individuals. Blacks Medical Dictionary classifies sunstroke, heat stress, and heat stroke into one category of non-battle casualties. 4

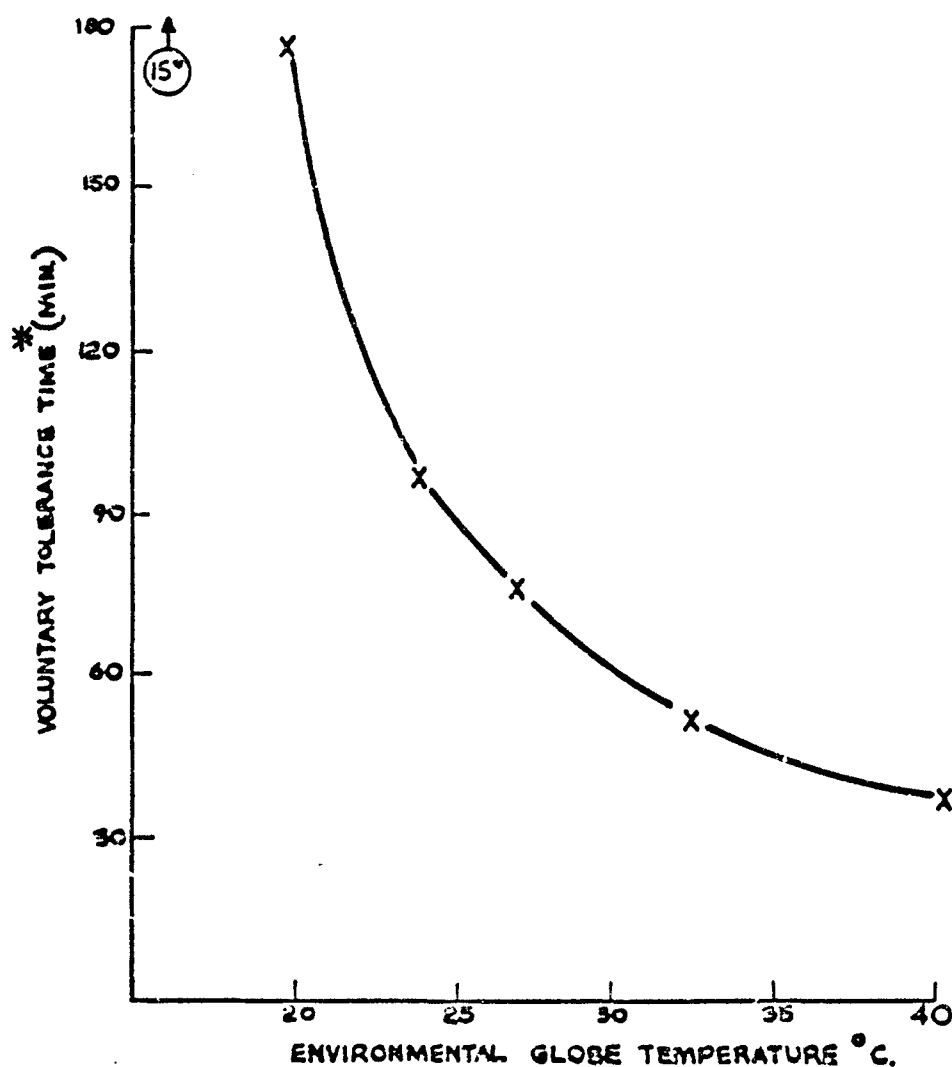
Table 7
Results Of Men Performing Heavy Work

Globe Temperature	CLIMATE						
	A 40°C	B 27°C	C 32.2°C	D 27°C	E 15.2°C	F 20°C	G 24°C
Individual Tolerance Times* (min)	32	70	45	75			100
	40	70	42	90			105
	40 ⁽¹⁾	70	50	65	130+	130+	93
	42	72	52	70			95
	40 ⁽²⁾	71	55	90			94
	33	80	56.5	75 ⁽²⁾			90
MEAN	37.8	72.1	50.1	77.5	130+	175 ⁽³⁾	96.2
SD	4.22	3.92	5.66	10.35		18.2	5.42

The stages of sunstroke are defined as heat collapse, heat exhaustion, heat cramps, and heat hyperpyrexia. The early symptoms are fatigue, giddiness, and temporary loss of consciousness.

Heat exhaustion is the next level and is denoted by weakness, dizziness and insomnia. The third stage is heat cramps and is characterized by a feeling of intense anxiety, headaches, giddiness.

This last stage, heat hyperpyrexia, is the last and most serious stage. Its symptoms are a cessation of sweating, loss of energy, irritability, extreme mental confusion which becomes worse until the subject falls into a



* TIMES INCLUDE AN INITIAL 10 MIN. AT REST.

THE MEAN TOLERANCE TIMES* OF GROUPS
OF 6 MEN, WEARING AN IMPERMEABLE CLOTHING ASSEMBLY
AND WORKING AT AN ENERGY EXPENDITURE OF 300 KCAL/HR.,
FOR 7 DIFFERENT ENVIRONMENTAL CONDITIONS.

Figure 19. Results Of Men Performing Heavy Work (From Safe Exposure Times For Men Wearing An Impermeable Clothing Assembly In Hot Conditions, 1968, pg. Figure 2)

coma. 5 The main point is that a heat casualty's common sense and ability to think through a problem is impaired before he becomes a hospital case.

The last study I will cite, on the subject of work/rest time of soldiers in MOPP4, is the U.S. Army Materiel Systems Analysis Activity November 1981 study headed by J.A. Rakaczky. This study concentrated on the effects of chemical protective clothing (MOPP gear) on general combat efficiency. TABLE 8 shows that when doing very heavy work in temperatures of 85-degrees Fahrenheit, a soldier can only work fifteen minutes without becoming a heat casualty. The

Table 8
Work/Rest Times (Minutes)

TEMPERATURE	WORK LOAD	BASELINE (2)		MOPP 4	
		WORK TIME	REST TIME	WORK TIME	REST TIME
-7°C	LIGHT	NHB (3)	15	NHB	20
(10°F)	MODERATE	NHB	15	NHB	30
	HEAVY	NHB	15	30	30
10°C	LIGHT	NHB	15	NHB	30
(50°F)	MODERATE	NHB	15	NHB	50
	HEAVY	NHB	15	25	50
29°C	LIGHT	180	20	60	00
(85°F)	MODERATE	90	50	40	00
	HEAVY	25	70	15	00

(1) Data extracted from Appendix H, Annex III, 61 JTRG/ME-75-13, pages H-56, H-57 and H-58 (Reference 24).

(2) Uniform is that normally worn in keeping with conditions; no NBC protection.

(3) NHB - No heat build-up; personnel can work for 2 hours or more and not build up sufficient heat to be degraded.

aspect of this study which makes it valuable is that Dr. Rakaczky translates to military terms light, moderate and heavy tasks to them as typical infantry skills. These are shown on attached FIGURES 20, 21 and 22.

Some examples of the usefulness of this report are as follows:

- a) Given an outside temperature of 80-degrees Fahrenheit, a soldier in MOPP4 will take 120 minutes to conduct a 500 meter dismounted infantry assault against an exposed objective. In MOPP0, the time is cut to 20 minutes.
- b) Given an outside temperature of 80-degrees Fahrenheit, it will take 360 minutes for soldiers in MOPP4 to complete a four-kilometer road march. The time for MOPP0 is 60 minutes.
- c) Given an outside temperature of 85-degrees Fahrenheit, it will take soldiers in MOPP4, 15 minutes to displace a battalion's tactical operations center (TOC) 500 meters. In MOPP0, it would take 5 minutes. 6

The ability of soldiers to communicate was not evaluated in this study.

Communication of a dismounted infantry squad in MOPP4 was tested from 17 - 29 October at Fort Hunter Liggett, California. This 11-day test also included assessing the ability of a squad to move in daylight as well as periods of limited visibility. The test personnel had to traverse two different daylight courses and one course in the evening. The two daylight areas traversed were both 450 meters by 350 meters and the area used for limited visibility operations was 250 by 190 meters.

TABLE 6 - Performance Degradation Data for Infantry Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4/C FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Squad, 9 men	Maintenance	Clean weapon	Light	15 min	20 min	20 min	20 min
	Position preparation, 2-man	Hasty, minimum protection.					
		In sand	Heavy	10 min	20 min	30 min	60 min
		In clay	Heavy	120 min	240 min	360 min	720 min
		In plowed, loose dirt	Heavy	30 min	60 min	90 min	120 min
		Deliberate, improved protection.					
		In sand	Heavy	20 min	40 min	60 min	120 min
		In clay	Heavy	240 min	480 min	720 min	1440 min
		In plowed, loose dirt	Heavy	60 min	120 min	180 min	360 min
		4 km @ 4 km/hr	Heavy	60 min	120 min	180 min	360 min
Maintenance Bn	Good march (normal)	Fast walk, 6 km/hr	Heavy	20 min	40 min	60 min	120 min
	Assault, 500 meters against moderate opposition	Protected					
	Rest, relief, mess	15 km, refuel 4 vehicles, 15 km return, refill tanker	Light	Variable	Variable	Variable	Variable
	Refuel four M113's, turn around times for Bn fuel tankers (1)(2)		Light - Moderate	3.5 hrs	3.5 hrs	3.5 hrs	10.5 hrs
	Ammunition resupply, turn around time for Bn trucks (2)(3)						
		15 km, unload, 15 km return, reload truck	Light - Heavy	1.5 hrs	3.0 hrs	4.5 hrs	9.0 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Figure 20. Performance Of Infantry Units (From The Effect Of Chemical Protective Clothing And Equipment On Combat Efficiency, 1981 pg. 42)

TABLE 2a - Performance Degradation Data for Infantry Units in a Chemical Warfare (CW) Environment.**

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (F/U/L PROTECTIVE ENSEMBLE)	
					820°F (-7°C)	850°F (10°C)	885°F (29°C)
TOW Crew	Firing Operation	(1) Mount TOW on M113A1 (TOW) for extended travel	(See Note 1) 2:16			(See Note 2) 5:00
		(2) Engage target from extended travel	0:50			1:23
		(3) Cease fire/out of action and move out in extended travel	0:59			1:16
		(4) Dismount TOW from extended travel	0:60			1:56
		(5) Engage target	0:19			0:44
		(6) Cease fire/out of action	0:16			0:16
		TOTAL ELAPSED TIME IN MINUTES	5:50			10:35
		Note 1: Condition is really MOPP 1 - Soldiers carry protective mask; other MOPP gear is readily accessible.				
Note 2: Temp. of test was 70°F						
**Information supplied in letter ATS-CD-MS-C, dtd 20 Feb 81.						

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Figure 21. Performance Of TOW Crew (From The Effect Of Chemical Protective Clothing And Equipment On Combat Efficiency, 1981, pg. 44)

TABLE 8 (continued) - Performance Degradation for Infantry Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					92°F (-7°C)	95°F (10°C)	98.5°F (29°C)
Bn HQ (Combat)	Site displacement (4)	Hasty, 500 meters	Moderate	5 min	5 min	15 min
	Site emplacement	Hasty, erect antenna	Heavy	10 min	20 min	60 min
	Displacement	Move of 10 km or more, time from notification to march order	Heavy	35 min (6)	70 min	210 min
	Emplacement, time to become operational upon arrival at new site.	Calligraphic, POL	Light	Immediate	Immediate	Immediate
		Ammo	Light	Immediate	Immediate	Immediate
OS Maintenance (5)	Mess	Heavy	45 min	90 min	135 min	
	Maintenance	Heavy	2 hrs	4 hrs	6 hrs	

(1) Maintenance Co assumed to be 15 km back of FEBA.

(2) Re resupply vehicles will travel as far as reserve company area and refuel vehicles or transfer ammunition to company vehicles.

(3) Ammunition arrives at the Bn crates and palletized. Bn breaks down the ammunition for specific company requests. Transfers of all ammunition below Bn are manual.

(4) Bn commander operates out of an M113 (stretch). Major task for this unit is the erection and dismantling of an M292 antenna. Generally located about 2 km back of company positions.

(5) Generally 20 km back of the FEBA.

(6) Road march time is not included.

(1) Maintenance Co assumed to be 15 km back of FEBA.

(2) Resupply vehicles will travel as far as reserve company area and refuel vehicles or transfer ammunition to company vehicles.

(3) Ammunition arrives at the Bn crated and palletized. Bn breaks down the ammunition for specific company requests. Transfers of all ammunition below Bn are manual.

(4) Bn commander operates out of an M113 (stretch). Major task for this unit is the erection and dismantling of M292 antenna. Generally located about 2 km back of company positions.

(5) Generally 20 km back of the FEBA.

(6) Road march time is not included.

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Figure 22. Performance of BN HQ (From The Effect Of Chemical Protective Clothing And Equipment On Combat Efficiency, 1981, pg. 43)

TABLE 9 displays the results of how accurately soldiers in MOPP4 reported pertinent information by radio. The baseline group remained in MOPP0 and the other MOPP levels are indicated on the table. As Table 9 indicates radio reporting accuracy decreased by at least 32.6%. This study

Table 9
Communications Test Results

Table 6-7. COMMUNICATIONS TEST RESULTS

Baseline		MOPP2		MOPP4	
Field	Control	Field	Control	Field	Control
MO 100.0%	FL 97.6%	FA 97.6%	CR 88.0%	FA 80.8%	FL 74.0%
FA 100.0	CR 100.0	KI 88.0	HE 83.2	KI 71.2	HE 50.0
KI 100.0	HE 97.6	MO 92.8	MA 87.6	MO 92.8	MA 80.2
BE 100.0	TH 97.6			FA 92.8	TH 59.2
	MA 100.0	BE 95.2	TH 78.4	BE 90.4	TH 66.4
N = 4	N = 5	N = 4	N = 4	N = 5	N = 5
Mean = 100.0%	Mean = 98.6%	Mean = 93.4%	Mean = 86.8%	Mean = 85.6%	Mean = 66.0%
SD = 0.0	SD = 1.3	SD = 4.1	SD = 8.2	SD = 9.4	SD = 11.9

Note: Letters before numbers identify individuals. For MOPP2 and MOPP4 in any row, the indicated results were for those individuals in any one trial. The baseline results are just a list of the individuals who appear in the MOPP2 and MOPP4 columns.

did not evaluate how long radio transmissions lasted while in MOPP4. This point will be covered in the next "lesson learned".

The last facet I will cover under this "lesson learned" is the inordinate amount of time that elapsed before soldiers realized that they did not have a commander. The information for this conclusion came from the findings of both of the Combined Arms In A Nuclear/Chemical Environment Force Development (CANE FDTE I and II) tests.

CANE FDTE I only dealt with platoon level units. The results are as follows:

1. The proportion of platoon leaders killed in the chemical attack increased by 34% from the baseline. However, in a chemical defense the leader attrition decreased by 54%. The majority of leaders that were killed (83%) were eliminated by direct fire, not by chemical agent exposure.
2. The average time to replace a lost commander increased from 1.4 minutes, noted in the base line, to 6.2 minutes in a chemical environment. Some units never replaced the leader. This is an increase of 343%. 7 The base line unit was the same soldiers performing the same tasks in MOPP0.

CANE FDTE II gave identical data for company level leader losses. The study gave two reasons for the high attrition of and slow replacement rate for leaders: (1) the inability of the soldiers to recognize leaders in MOPP4 and (2) the difficulty with understanding orders sent by radio. CANE FDTE I concluded that command and control was degraded

considerably in the chemical environment. The main reason was that the leaders and the soldiers were dehydrated and fatigued. To appreciate the full impact of this statement, one must realize that the soldiers tested were in vehicles, they were in MOPP4 for only 72 hours and the average temperature did not exceed 70-degrees fahrenheit.8 The conditions would worsen if the soldiers were afoot or in MOPP4 for a longer period of time. An increase in temperature would also increase the problems.

LESSON #2-- Face-to-face communication are only one-half as effective in the chemical environment as in a no-threat environment and 38% of all radio messages must be repeated while in MOPP4.

A. Applicable Experiments/Studies

1. Combined Arms In A Nuclear/Chemical Environment Force Development Test (CANE FDTE I), Volumes I, II, III; U.S. Army Chemical School, January 1984

2. Combined Arms In A Nuclear/Chemical Environment Force Development Test (CANE FDTE II), Volumes I, II, III; U.S. Army Chemical School, January 1986

B. Scenario Application

<u>UNIT</u>	<u>DATE</u>	<u>TIME</u>
Division A	D Day	1707

Division A	D Day	2130
Division A	D + 1	0200
Division A	D + 1	0610
Division A	D + 1	1050
Division A	D + 1	1105
Division B	D - 2	2300
Division B	D - 1	0630
Division B	D Day	1757
Division B	D + 1	1130
Division B	D + 1	1230
Division B	D + 1	1830
Division B	D + 2	0730

C. Correlation

CANE FDTE I determined that during battle segments radio message frequency increased by 47% while in MOPP4. The duration of the radio message increased by 53%. During movement operations, radio message frequency decreased by 8% while in MOPP4. The duration increased by 4%. During stationary segments, frequency increased by 119% while in MOPP4, but duration decreased by 3%.9

This study recorded subjective observations that concluded the increased duration of the radio message was mainly due to the players' perceived inability to understand the initial transmission. However, every message was

recorded and the majority were surprisingly clear. Much less face-to-face verbal communication occurred while the soldiers were in MOPP4. The observers also noted that the players used many more hand signals and gestures to communicate.

CANE FDTE II analyzed both the Battalion and Company radio nets. Tables 10 and 11 indicate the number of radio messages that were sent over the Battalion and Company Command Radio Nets respectively. Note the column which indicates the amount of messages that had to be repeated or clarified. The gross totals are 47% of all messages sent over the Battalion Command Net and 29.6% of all Company Command Net messages had to be repeated or clarified.

Table 10

BN Command Radio Net Results

TABLE 9-8. NUMBER OF MESSAGES REPEATED AND CLARIFIED

Scenario	Day	Mask cond	No of msgs	Repeats			Clarifications	
				Mean	Median	SD	No of msgs	Percent
Battalion command net								
B1	1	Off	15	1.3	1.0	2.3	8	53.3
B1	2	Off	20	0.9	0.0	1.2	8	40.0
B1	3	Off	46	0.7	0.0	1.1	15	31.2
M1	1	Off	1	1.0	1.0	--	1	100.0
M1	1	On	5	0.6	0.0	0.9	2	40.0
M1	2	Off	13	0.6	0.0	1.0	5	38.5
M1	2	On	7	0.1	0.0	0.4	1	14.3
M1	3	Off	11	0.2	0.0	0.4	2	18.2
M1	3	On	1	1.0	1.0	--	1	100.0
M2	1	Off	3	1.0	1.0	0.0	3	100.0
M2	1	On	1	0.0	0.0	--	0	--
M2	2	Off	4	0.0	0.0	0.0	0	--
M2	2	On	11	0.5	0.0	0.7	3	27.3
M2	3	On	26	0.0	0.0	0.0	3	11.5
B2	1	Off	9	0.3	0.0	0.5	3	33.3
B2	2	Off	2	0.0	0.0	0.0	0	--
B2	3	Off	2	0.5	0.5	0.7	1	50.0

Table 12 indicates the result of the mean time to transmit a message while in MOPP4 versus MOPP0. The time to send the same type of message increases anywhere from .5 to 2.4 minutes. This time only includes initial transmission of the message, not the time taken for repeats or clarification.

CANE FDTE I subjectively concluded that mainly due to the increase of leader activity during periods in MOPP4,

Table 11
Company Command Radio Net Results

TABLE 9-4 (CONT). NUMBER OF MESSAGES REPEATED AND CLARIFIED

Scenario	Day	Mask cond	No of msgs	Repeats			Clarifications	
				Mean	Median	SD	No of msgs	Percent
Company command net								
B1	1	Off	38	0.7	0.0	1.6	10	26.3
B1	2	Off	58	0.1	0.0	0.3	3	5.2
B1	3	Off	36	0.0	0.0	0.0	0	--
N1	1	On	13	0.3	0.0	0.5	4	30.8
N1	2	Off	1	0.0	0.0	--	0	--
N1	2	On	19	0.4	0.0	0.6	7	36.8
N1	3	Off	23	0.6	0.0	0.9	9	39.1
N1	3	On	28	0.5	0.0	1.0	7	25.0
N2	1	Off	3	0.0	0.0	0.0	3	100.0
N2	1	On	3	0.0	0.0	0.0	0	--
N2	2	Off	4	0.3	0.0	0.5	1	25.0
N2	2	On	33	0.4	0.0	0.5	7	21.2
N2	3	Off	1	0.0	0.0	--	0	--
N2	3	On	18	0.1	0.0	0.2	1	5.6
B2	1	Off	19	0.0	0.0	0.0	0	--
B2	2	Off	23	0.1	0.0	0.5	2	8.7
B2	3	Off	16	0.3	0.0	0.5	5	31.3

higher leader attrition rate while in MOPP4, results of all communication statistics, and increased periods while

leaders were not replaced, the following blanket statement was made, "communication was degraded by at least 50% in the NCE (nuclear/chemical environment)". 10 All radio

Table 12

Time Taken To Transmit Messages

TABLE 9-9. TIMES TO TRANSMIT AND REPORT MESSAGES

Scenario	Day	Mask cond	No of msgs	Time to transmit			Msgs reported on time	
				Mean	Median	SD	No	Percent
Battalion command net								
B1	1	Off	39	72.0	52.0	60.4	38	97.4
B1	2	Off	75	61.6	38.0	64.9	69	92.0
B1	3	Off	45	82.7	58.0	114.3	43	95.6
N1	1	Off	13	33.2	65.0	57.6	13	100.0
N1	1	On	61	59.2	49.0	43.2	50	82.0
N1	2	On	19	121.2	69.0	120.2	16	84.2
N1	3	Off	3	48.3	31.0	37.2	3	100.0
N1	3	On	38	48.9	31.0	46.2	36	94.7
N2	1	Off	6	107.2	98.5	62.3	6	100.0
N2	1	On	20	278.4	84.5	767.4	20	100.0
N2	2	On	9	62.0	60.0	31.8	9	100.0
N2	3	On	10	79.7	82.5	48.5	10	100.0
B2	1	Off	33	82.3	67.0	74.0	33	100.0
B2	2	Off	5	78.8	90.0	19.8	4	80.0
B2	3	Off	18	105.5	62.0	116.1	16	88.9
Company command net								
B1	1	Off	38	33.0	22.0	33.4	38	100.0
B1	2	Off	58	47.1	27.0	58.3	58	100.0
B1	3	Off	36	68.1	39.0	84.5	36	100.0
N1	1	On	13	58.7	49.0	48.7	13	100.0
N1	2	Off	1	10.0	10.0	--	1	100.0
N1	2	On	19	45.0	38.0	29.6	19	100.0
N1	3	Off	23	57.2	51.0	37.6	23	100.0
N1	3	On	28	66.0	33.0	78.8	28	100.0
N2	1	Off	3	174.3	123.0	190.3	3	100.0
N2	1	On	3	20.3	16.0	11.2	3	100.0
N2	2	Off	4	45.8	34.0	42.5	4	100.0
N2	2	On	33	53.5	26.0	92.0	33	100.0
N2	3	Off	1	41.0	41.0	--	1	100.0
N2	3	On	18	35.7	28.5	24.8	14	77.8
B2	1	Off	19	17.9	10.0	22.6	19	100.0
B2	2	Off	23	22.9	8.0	42.2	23	100.0
B2	3	Off	16	44.4	34.0	30.0	16	100.0

transmissions were recorded and reviewed to verify the results shown in the previous tables as well as the conclusion above.

CANE FDTE II also evaluated other areas that were rolled into one criterion. This criterion was the ability of the Combined Arms Force to establish, maintain, and operate communications during sustained combat operations.¹¹ TABLE 13, the summary table, is on the following page. The other sub-areas that were evaluated were the ability of indirect fire support units to establish and maintain communications during sustained combat operations, time required to set up communication facilities, time required to tear down communication facilities and time required to perform communication tasks.

Table 13
Summary Of Unit Communications

TABLE 9-1. CONSOLIDATED RANKINGS OF UNIT ABILITY TO ESTABLISH, MAINTAIN, AND OPERATE UNIT COMMUNICATIONS

Scenario	Day	MOPP level	Total	Distribution of rankings						Mean	Med	SD
				R1	R2	R3	R4	R5	Other			
B1	1	None	351	58	128	23	4	1	137	1.89	2	0.70
B1	2	None	243	42	101	26	4	5	65	2.04	2	0.85
B1	3	None	216	41	87	17	3	1	67	1.90	2	0.72
M1	1	2-4	405	17	173	48	4	2	161	2.18	2	0.61
M1	2	2-4	243	25	96	17	14	16	75	2.40	2	1.13
M1	3	2-4	189	8	88	18	9	7	59	2.38	2	0.91
N2	1	2-4	351	10	178	41	10	1	111	2.22	2	0.61
N2	2	2-4	297	2	152	38	10	15	80	2.47	2	0.88
N2	3	2-4	216	7	107	17	3	4	78	2.20	2	0.70
B2	1	None	324	14	180	32	7	1	90	2.15	2	0.58
B2	2	None	243	12	116	51	16	12	36	2.52	2	0.93
B2	3	None	162	5	86	21	15	12	23	2.59	2	1.03

TABLE 13 also indicates that for the majority of the trials performed in MOPP gear, the task of maintaining communications was accomplished with little difficulty. The R2 column, where most of the numbers reside, means the task tested was accomplished with little difficulty. Unfortunately, this study did not establish a baseline (task performed while in MOPP0) for communication set up or the tear down of the various tested units.

LESSON #3-- Battalion TOC efficiency suffers significantly in a chemical environment because of the following: (a) written work and radio/telephone communications are subject to 40% more errors, (b) organic M51 Shelters cannot house a functional staff, and (c) more reliance is placed on gathering intelligence instead of planning for mission execution.

A. Applicable Experiments/Studies

1. Force Development Testing And Experimentation Evaluation Of Collective Protection For Command, Control and Communication Activities (ILL WIND), U.S. Army Infantry Board, December 1977.

2. The Effect Of Chemical Protective Clothing And Equipment On Combat Efficiency, U.S. Army Material Systems Analysis Activity , November 1981.

B. Scenario Application

<u>UNIT</u>	<u>DATE</u>	<u>TIME</u>
Division A	D - 2	2330
Division A	D + 1	0330
Division A	D + 1	1105
Division A	D + 1	1300
Division B	D - 1	2300
Division B	D Day	1835
Division B	D + 1	1159
Division B	D + 2	0830

C. Correlation

One of the major findings of the December 1977 U.S. Army Infantry Board Study of the collective protection for command, control and communication activities of an infantry battalion was that operations in MOPP4 adversely affect the activities of a battalion TOC. Another key finding is that the M51 Shelter System provides a satisfactory work environment for TOC personnel; however, this advantage is offset by the reduced efficiency of other staff elements of the TOC which are forced outside of the M51 Shelter system because of space constraints.¹² The one major deficiency of this test was the meteorological conditions. Since this test was conducted at Fort Benning, Georgia from 7 September to 7 October 1977, only moderate temperatures were noted.

The data from this test is exemplary since it was gained by testing two different battalion staffs operating in two different locations at Fort Benning. Also, some of the results obtained are supported by the November 1981 study conducted by Dr. J.A. Rakaczky on how chemical protective clothing affect combat efficiency and the January 1986 CANE FDTE II study on survival on a chemical battlefield.

TABLES 14 and 15 indicate the amount of time the staffs took to set up and dismantle a Battalion TOC during

Table 14
Time To Set Up And Tear Down TOC

TABLE 2-2. TIMES IN MINUTES REQUIRED FOR
STAFF NO 1 TO SET UP AND BREAK DOWN TOC

		PHASE I		PHASE II	
		SET UP	BREAK DOWN	SET UP	BREAK DOWN
Initial Set Up		31		35	
Move No 1	Break Down		20		12
	Set Up	29		32	
Move No 2	Break Down		13		16*
	Set Up	15		19	
Final Break Down			07		13
Averages		25.0	13.3	23.7	13.7
* Accomplished in complete protection.					

the Fort Benning study. Phase I of the test was performed in MOPPO while Phase II was done in MOPP4. These tables

Table 15
Time To Set Up And Tear Down BN TOC

TABLE 2-3. TIMES IN MINUTES REQUIRED FOR
STAFF NO 2 TO SET UP AND BREAK DOWN TOC

		PHASE I		PHASE II	
		SET UP	BREAK DOWN	SET UP	BREAK DOWN
Initial Set Up		13		31	
Move No 1	Break Down		20		31
	Set Up	27		33	
Move No 2	Break Down		11		42*
	Set Up	12		31	
Final Break Down			12		28
Averages		17.3	14.3	32.3	33.7
* Accomplished in complete protection.					

indicate that set up took from 3.7 to 15 minutes longer and tear down took .4 to 19.4 minutes longer. This is supported by the November 1981 Rakaczky study as shown in FIGURE 22.

FIGURE 22 illustrates that soldiers in MOPP4, depending on the temperature, take between 10 to 50 minutes longer to erect a M292 antenna and 0 to 10 minutes longer to displace a small headquarters 500 meters.

The last aspect of TOC operation is a measure of its efficiency in a chemical environment. The two studies I used were the December 1977 Fort Benning study and CANE FDTE II. The specific efficiency gauges used by Fort Benning

were the times to prepare and the errors noted in preparing written orders and plans as well as time in minutes to transmit and acknowledge typical messages. CANE FDTE II measured the ability of a commander to issue fragmentary orders and operation orders in a timely manner.

The Fort Benning study, TABLES 16 and 17, indicates the

Table 16

Time To Prepare Written Orders

TABLE 2-7. STAFF NO 1 - TIMES TO PREPARE
AND ERRORS NOTED IN PREPARING
WRITTEN ORDERS AND PLANS

ACTIVITY	PHASE I	PHASE II	CHANGE
RELIEF ORDER:			
*Time/Errors	5:53 / 2	5:15 / 1	- :20 / 1
Protection Level	NA	Partial	
ATTACK ORDER:			
*Time/Errors	4:42 / 0	6:34 / 1	+ 1:52 / +1
Protection Level	NA	Complete	
I-CO RELIEF PLAN			
*Time/Errors	1:20 / 1	2:17 / 0	+ :57 / -1
Protection Level	NA	Complete	
COUNTERATTACK PLAN			
*Time/Errors	4:06 / 1	3:48 / 1	- :18 / 0
Protection Level	NA	Complete	
Totals For All Items	16:01 / 4	17:54 / 3	+1:53 / -1
			+11% / -25%
Totals for Items Prepared in Complete Protection (Last 3 Items)	10:08 / 2	12:39 / 2	+2:31 / 0
			+25% / 0

* Time in hours:minutes.

time and noted errors in preparing written orders and plans. The results were mixed. Overall, one staff took less time with no errors noted in MOPP4 and the other staff took more time with the same number of errors noted as when they were in MOPP0.

Table 17
Time To Prepare Written Orders

TABLE 2-3. STAFF NO 2 - TIMES TO PREPARE
AND ERRORS NOTED IN PREPARING
WRITTEN ORDERS AND PLANS

ACTIVITY	PHASE I	PHASE II	CHANGE
RELIEF ORDER:			
*Time/Errors	2:24 / 11	2:13 / 4	+ :09 / -7
ATTACK ORDER:			
*Time/Errors	3:37 / 3	2:12 / 2	- 1:25 / -1
I-CO RELIEF PLAN			
*Time/Errors	:58 / 2	:48 / 2	- :10 / 0
COUNTERATTACK PLAN			
*Time/Errors	1:55 / 2	1:46 / 3	- :15 / +1
Total For All Items	8:45 / 18	7:13 / 11	-1:41 / -7
			-19% / -39%
Totals for Last 3 Items (See Table 2-7)	6:30 / 7	4:40 / 7	-1:30 / 0
			-28% / 0

* Time in Hours/minutes.

TABLES 18 and 19 indicate the increased time radio and telephone messages require while user personnel were in MOPP4. Messages took from 1 to 12 minutes longer to transmit and receive while in MOPP4.

Table 18
Time To Transmit Messages

TABLE 2-9. TIMES IN MINUTES TO TRANSMIT AND
ACKNOWLEDGE TYPICAL MESSAGES (STAFF NO 1)

MESSAGE NO AND MEANS OF COMMUNICATION	SENDER TIME TO TRANSMIT AND PROTECTION LEVEL	RECEIVER TIME TO ACKNOWLEDGE AND PROTECTION LEVEL
25 - Radio	2 - Unmasked	12 - Masked
26 - Phone	3 - Unmasked	16 - Masked
28 - Phone	2 - Masked	10 - Masked
31 - Radio	2 - Masked	4 - Unmasked
33 - Phone	2 - Unmasked	6 - Unmasked
34 - Radio	2 - Unmasked	5 - Unmasked

The CANE FDTF study results are shown in TABLES 20 and 21. TABLE 20 shows that almost all of the participants had some difficulty issuing timely fragmentary orders. Also, TABLE 21 indicates that a majority of leaders had major difficulties in issuing accurate and complete operations orders.

Table 19

Time To Transmit Messages

TABLE 2-10. TIMES IN MINUTES TO TRANSMIT AND
ACKNOWLEDGE TYPICAL MESSAGES (STAFF 2)

MESSAGE NO AND MEANS OF COMMUNICATION	SENDER TIME TO TRANSMIT AND PROTECTION LEVEL	RECEIVER TIME TO ACKNOWLEDGE AND PROTECTION LEVEL
25 - Radio	4 - Unmasked	12 - Unmasked
26 - Phone	6 - Unmasked	12 - Unmasked
28 - Phone	6 - Masked	10 - Unmasked
31 - Radio	3 - Masked	4 - Unmasked
33 - Phone	4 - Unmasked	6 - Unmasked
34 - Radio	4 - Unmasked	5 - Unmasked

Table 20

Leader's Ability To Issue FRAGO

TABLE 8-15. CONSOLIDATED RANKINGS OF COMMANDER'S ABILITY
TO ISSUE TIMELY FRAGO'S

Scenario	Day	MOPP level	Total	Distribution of rankings							Mean	Med	SD
				R1	R2	R3	R4	R5	Other				
B1	1	None	20	4	9	5	0	0	2	2.06	2	0.73	
B1	2	None	22	5	12	1	0	0	4	1.78	2	0.55	
B1	3	None	10	3	5	2	0	0	0	1.90	2	0.74	
N1	1	2-4	24	3	9	4	0	0	8	2.06	2	0.68	
N1	2	2-4	20	0	13	2	1	0	4	2.25	2	0.58	
N1	3	2-4	10	0	7	3	0	0	0	2.30	2	0.48	
N2	1	2-4	20	2	10	4	0	0	4	2.13	2	0.62	
N2	2	2-4	16	0	11	4	0	0	1	2.27	2	0.46	
N2	3	2-4	12	0	7	3	1	1	0	2.67	2	0.98	
B2	1	None	16	0	10	4	0	0	2	2.29	2	0.47	
B2	2	None	18	0	10	4	0	0	4	2.29	2	0.47	
B2	3	None	12	0	9	3	0	0	0	2.25	2	0.45	

Table 21

Leader's Ability To Issue OPNS Order

8.2.2.6 Measure of evaluation 6 - Ability of the CAF unit commander to issue the operation order. The consolidated rankings for this measure of evaluation are shown in table 8-7.

TABLE 8-7. CONSOLIDATED RANKINGS OF COMMANDER'S ABILITY TO ISSUE OPERATION ORDERS

Scenario	Day	MOPP level	Total	Distribution of rankings						Mean	Med	SD
				R1	R2	R3	R4	R5	Other			
B1	1	None	66	14	16	14	1	0	21	2.04	2	0.85
B1	2	None	66	22	17	7	1	0	19	1.72	2	0.80
B1	3	None	42	9	15	11	0	0	7	2.06	2	0.76
N1	1	2-4	78	13	24	9	1	0	31	1.96	2	0.75
N1	2	2-4	60	0	26	9	0	1	24	2.33	2	0.63
N1	3	2-4	48	2	16	10	2	1	17	2.48	2	0.85
N2	1	2-4	56	13	25	10	0	0	19	1.94	2	0.70
N2	2	2-4	48	2	16	18	1	1	10	2.55	3	0.76
N2	3	2-4	42	0	19	17	6	3	7	2.80	2	1.02
B2	1	None	48	1	26	9	4	1	7	2.46	2	0.81
B2	2	None	48	3	20	9	4	1	11	2.46	2	0.90
B2	3	None	42	2	22	9	4	0	5	2.41	2	0.76

LESSON #4-- Opposed amphibious assaults by soldiers in a tropical environment wearing MOPP4 are judged medically impossible.

A. Applicable Experiments/Studies

1. Safe Exposure Times For Men Wearing An Impermeable Clothing Assembly In Hot Conditions, Porton Technical Paper #989, March 1968.

2. The Effects of Chemical, Biological Clothing and Equipment on U.S. Army Soldier Performance: A Critical Review Of Literature, Andrulis Research Corporation, July 1980.

3. An Assessment Of CBR Protective Uniforms During An Amphibious Assault In A Tropical Environment: Heat Stress Study 69-10, U.S. Navy Department, Nov. 1969.

B. Scenario Application

Reference made to a planned amphibious assault in Chapter 4. In the scenario the planned amphibious assault was never conducted because of the chemical threat encountered by both divisions.

C. Correlation

The basis for this conclusion is the November 1969 study performed by the Naval Medical Field Research Laboratory at Camp Lejeune, North Carolina. The field test was conducted at Isla de Vieques, Puerto Rico on the men of the 1st Battalion, 8th Marine Regiment, 2d Marine Division.¹³ This test was a platoon size assault from a LSD (Landing Ship Dock) to LVTs (Landing Vehicle Tank) for a beach assault with a specific objective. The objective was occupied by an enemy force and was atop a 60 meter, 16% grade hill. This hill was located 100 meters from the

beach. The various uniforms that were tested are shown in
TABLE 22.

Table 22
Description Of Protective Clothing

DESCRIPTION OF UNIFORMS* INVESTIGATED IN HEAT STRESS STUDY 69-10

U Uniform, Standard, Utility

Shirt, Men's, Cotton, Sateen 8.5-oz., OG-107 (standard)
Undershirt, Men's, Cotton, Quarter Sleeve (standard)
Trousers, Men's, Utility, Cotton, 8.5-oz., OG-107 (standard)
Drawers, Men's, Cotton, Short (standard)

O Uniform, CBR Protective, Standard, Two-layer, OPEN

Shirt, Men's, Cotton, Sateen, 8.5-oz., OG-107, CC₃-treated (standard)
Trousers, Men's, Utility, Cotton, 8.5-oz., OG-107, CC₃-treated (standard)
Underwear, Shirt and Drawers, Cotton, White, Special, CC₃-treated (standard)

Carried but not donned initially

Gloves, Cotton, White, Special, CC₃-treated (standard)
Gas Mask (M 17A1)
Hood, Gas Mask (M 6A1)

C Uniform, CBR Protective, Standard, Two-layer, CLOSED

Identical to OPEN above but with gloves, gas mask and hood donned at the time of initial dress-out.

P OVERGARMENT, Prototype, CB Protective

Coat and Trousers, CB Protective, Overgarment
Undershirt, Men's, Cotton, Quarter Sleeve (standard)
Drawers, Men's, Cotton, Short (standard)

L Uniform, CBR Protective LINER

Shirt, Men's, Cotton, Sateen 8.5-oz., OG-107 (standard)
Liner, Shirt, Chemical Protective, Cotton Sateen, 8.0-oz., OG-107
Trousers, Men's, Utility, Cotton, 8.5-oz., OG-107 (standard)
Liner, Trousers, Chemical Protective, Cotton, Sateen, 8.0-oz., OG-107

***All uniforms worn with:**

Socks, Wool, Cushion-sole (standard)
Boot, Combat, Service, Mildew-resistant (standard)

It is worth noting that the findings of this study contradict the 1962 study of Poe, R.H., Davidson E.T. and G Brieger on the physiological responses of men wearing chemically impregnated clothing. Later studies support the conclusions of the Naval study.14,15,16

FIGURE 23 shows the result of the Naval study. This graph shows one of the platoon results, which typifies all the test results. The platoons never reached the objective with enough combat power to take it. Casualties were due to high level of seasickness while in MOPP4 and heat stress.

The platoons left the LSD at 100% combat power. By the time they landed on the beach, their combat power ranged from 60 to 70%. This loss was mainly due to increased seasickness. The seasickness was directly attributed to the MOPP equipment because of the suits ability to hold heat and the visual impairment caused by the M17A1 mask. Lastly, the average platoon combat power upon beginning the final assault on the objective fell between 10 to 20%. Consequently, no test platoon successfully captured the objective.

I could not locate any other studies that refute or corroborate these findings. Another similar 1981 study, conducted by the U.S. Army Infantry Board at Fort Benning, tested present parachute procedures. This test was not one of any particular hardware items but one that addressed doctrinal shortfalls. The test did address modifications to

4 May

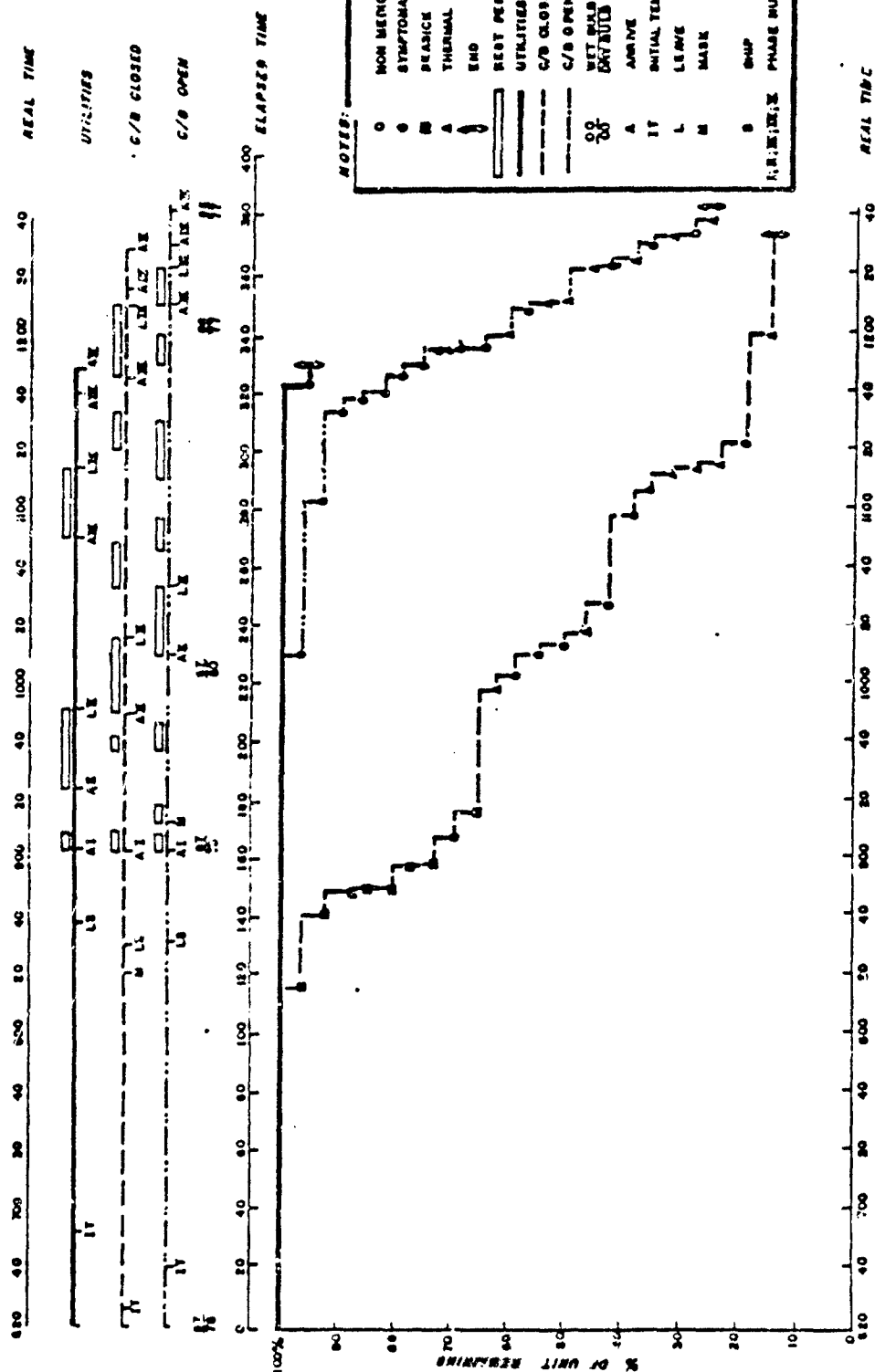


Fig. 3. Percent walk strength versus time graphs for Utilities, CB Closed and CB Open on 4 May 1969.

Figure 23. Amphibious Warfare Sample Results (From An Assessment Of CBR Protective Uniforms During An Amphibious Assault In A Tropical Environment: Heat Stress Study 69-10, 1969, pg. Figure 2)

present equipment so a parachutist can jump in MOPP4. The specific test objectives follow:

1. To identify any required changes to current marshalling area and in flight procedures when preparing to parachute into chemically contaminated areas.
2. To assess the individual parachutist's capability to accomplish the five points of performance while wearing and carrying MOPP4 in addition to other required weapons and equipment.
3. To assess the impact of the requirement for a parachutist to wear MOPP4 during a parachute operation on the capability of the unit to rapidly assemble.¹⁷

I found this parachutist test interesting because it never addressed tropical or arctic climates. I would have thought the possibility of extreme climates would play a major role in assessing the ability of a unit to rapidly assemble on a drop zone. The pertinent conclusions from this test were: (1) training of the soldier was the key to successful mission accomplishment, (2) a parachutist should not don helmet and mask until 10 minutes before boarding aircraft and don the CB gloves at the 10-minute warning, (3) a parachutist needs to clear and seal his mask after checking his canopy and (4) the current chin strap is inadequate.

LESSON #5-- Training is the single most important factor in preparing to fight and win on a chemical battlefield.

A. Applicable Experiments/Studies

1. Combined Arms In A Nuclear/Chemical Environment Force Development Test (CANE FDTE I), Volumes I, II, III, U.S. Army Chemical School, January 1984.
2. Combined Arms In A Nuclear/Chemical Environment Force Development Test (CANE FDTE II), Volumes I, II, III, U.S. Army Chemical School, January 1986.
3. Force Development Testing And Experimentation Of Parachute Procedures In Chemically Contaminated Areas (PAPRICCA), U.S. Army Infantry Board, January 1984.
4. An Assessment Of CBR Protective Uniforms During An Amphibious Assault In A Tropical Environment: Heat Stress Study 69-10, U.S. Navy Department, Nov. 1969.

B. Scenario Application

<u>UNIT</u>	<u>DATE</u>	<u>TIME</u>
Division A	D - 2	2130
Division A	D - 1	0500
Division A	D - 1	FRAGO #1
Division A	D Day	2130
Division A	D + 1	1000
Division A	D + 1	1020
Division B	D - 2	0525
Division B	D - 2	2200
Division B	D - 1	0630
Division B	D - 1	0930

Division B	D - 1	1500
Division B	D - 1	1800
Division B	D Day	2200

C. Correlation

Good chemical training is the easiest and most reliable method of developing proficiency in a skill and, thereby, building self-confidence. General Fries in his book, Chemical Warfare writes:

"Cloud gas will usually be put off at night because the cloud cannot be seen, because then men are tired and sleepy, and all but the most highly trained become panicky. Under these conditions the greatest casualties result." 18

General Ludendorff, Chief Of the German Staff, realized how effective good gas training was. In an order he published as a result of the French use of mustard gas he wrote:

"Our Yellow Cross (mustard gas shell) has caused much damage to the enemy, formerly less protected than now. But as a natural sequence, he has developed through it a gas discipline which can certainly be taken as model. On this account enemy troops have been able to cross, at once and without loss, areas which their artillery had just bombarded with gas. We also must train our troops to an excellent standard of gas discipline if we expect to avoid the grave danger which threatens " 19

Today we hold with the same thoughts on training and employment of chemical munitions in our U.S. Army field manuals.

Fear and panic can be prevented in soldiers, especially in a chemical environment, by (1) recognizing and evacuating the worst cases of fear and anxiety, (2) education, (3) training, (4) good intelligence, (5) leadership, and (6) mutual security. 20 Most medical personnel will agree that if a soldier feels he understands an event, that event will not unduly worry him. Thus anxiety and stress can be reduced.

Leadership usually goes hand-in-hand with training. In my opinion, the Army needs to focus training on three key leader areas; (1) leader attitude, (2) leader education, and (3) leader presence. To be confident in his role and respected by his soldiers a leader should go beyond the prerequisite MOS Skill Knowledge on chemicals required of his soldiers. A leader's attitude toward chemical training is critical to the amount of unit chemical training conducted and the real benefit the soldiers gain from that training.

Lastly, if the chain of command is present at an event, that presence is usually the signal to soldiers that the event is important. Likewise, the fact that a leader is present at a specific location in combat at a critical time not only helps the morale of the soldiers but aids junior leaders in execution of their mission. Also, this command presence reinforces to the soldier that their boss is really concerned. Studies have shown that while in MOPP4 the

presence of a leader will be diminished. However, through techniques such as painted symbols, soldiers can still identify leaders.

PART III -- RECOMMENDATION FOR FUTURE STUDY AND ANALYSIS

1. Effects of chemical agents on troops, performing moderate work, wearing MOPP4.
2. Effects of chemical agents in a tropical environment on troops and equipment.
3. The effectiveness of the Battalion TOC Shelters.
4. Determine methods to improve radio communication, while in MOPP4.
5. Analysis of a proper training program to adequately prepare a soldier for combat in a chemical environment.
6. Analysis of the VIC computer simulation/CPX exercise to determine if a battalion/brigade/division staff receives realistic data on operations in a chemical environment.
7. Build into a computer simulation the factors of communication difficulty and leader fatigue on a chemical battlefield.

8. Testing of the unit chemical alarm to determine its effectiveness and ease of operation.
9. Testing of the Air Force Tactical Air Control Party Doctrine to determine if it aligns with Army doctrine for operations in a chemical environment.
10. Testing of the feasibility of an amphibious assault in MOPP4, in a tropical environment.
11. Testing of the feasibility of an airborne drop in MOPP4, into a contaminated drop zone in a tropical environment.
12. Analysis of how well the future battalion and brigade level CAME FDTE IIB and III studies relate to actual unit field conditions in a chemical environment.

Specific next steps might include:

1. Develop division-level training and operations plans that would fully prepare a third LID for the combat operations outlined in Chapter 4.
2. A critical analysis of U.S. Army tactical doctrine for operations on a chemical battlefield.

3. A critical analysis of how efficient the combat service support elements of a U.S. Army Corps would be on a chemical battlefield.

ENDNOTES FOR CHAPTER 5

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²Ibid., D-31.

³F.N. Craig and H.L. Froenlich, Endurance of Overheated Men In Exhausting Work, Department of the Army, Edgewood Arsenal Md, July 1968: 18.

⁴John Dixon Comrie, Black's Medical Dictionary, London, England (1976): 817.

⁵Ibid., 817-818.

⁶John Rakaczky, The Effect Of Chemical Protective Clothing And Equipment On Combat Efficiency, US Army Combat Development Command, Fort Ord, CA November 1981: 41-44.

⁷Staff, Combined Arms In A Nuclear/Chemical Environment Force Development Test And Experimentation (CANE FDTE) Phase I, VOL I, January 1984: 2-7 to 2-8.

⁸Ibid., pg 2-10.

⁹Ibid.

¹⁰Ibid., pg 2-11.

¹¹Staff, Combined Arms In A Nuclear/Chemical Environment Force Development Test And Experimentation (CANE FDTE) Phase II, VOL I, January 1986: 9-2.

¹²William Reynolds, Force Development And Experimentation Of Collective Protection For Command And Control And Communication Activities (ILL WIND), US Army Infantry Board, Fort Benning, GA, December 1977: 1-6.

¹³William E. Yarger and Peter L. Schwartz, An Assessment Of CBR Protective Uniforms During An Amphibious Assault In A Tropical Environment: Heat Stress Study 69-10, Naval Medical Field Research Lab, Camp Lejeune NC, November 1969: 2

¹⁴Poe, R.H., E.T. Davidson, and G. Brieger. The physiological responses of men wearing chemically impregnated clothing in a hot dry climate. "Mil. Med." 127:436-441, 1962.

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¹⁸Amos Fries and Clarence West, Chemical Warfare, New York (1923): 373

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²⁰Ibid., pgs 14 to 19

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APPENDIX A

Key Communication Events For Division A

<u>DAY</u>	<u>TIME</u>	<u>EXPLANATION</u>
D - 2	2330	SMAJ & INTEL MSG
D - 1	0500	CDR's Objective
	AM	FRAGO #1
	2345	Bad attitude
D DAY	1707	Mine field
	2130	Fear of NBC
D + 1	0200	Radio repeats
	0300	Cancel Airborne
	0445	Dirty LZ
	0610	Heat casualty
	1020	PSG Heads up
	1105	Write msg in MOPP
	1300	TAC slow motion
D + 2	0100	Heat/fatigue
	0300	Training is key

APPENDIX B

Key Communication Events for Division B

<u>DAY</u>	<u>TIME</u>	<u>EXPLANATION</u>
D - 2	0525	Unit Integrity
	2200	Team Building
	2300	Courier Actions
D - 1	0600	PT in MOPP4
	0630	BN CDR COMMO CLASS
	0830	Realistic Training
	1500	Commanders' Class
D DAY	1100	Heat casualties
	1757	Use of runner
	1835	SOPs
	2200	Use of mask carrier
D + 1	1130	Radio message
	1133	Radio frustration
	1300	Commanders presence
D + 2	0730	River Crossing
	0830	TACP actions